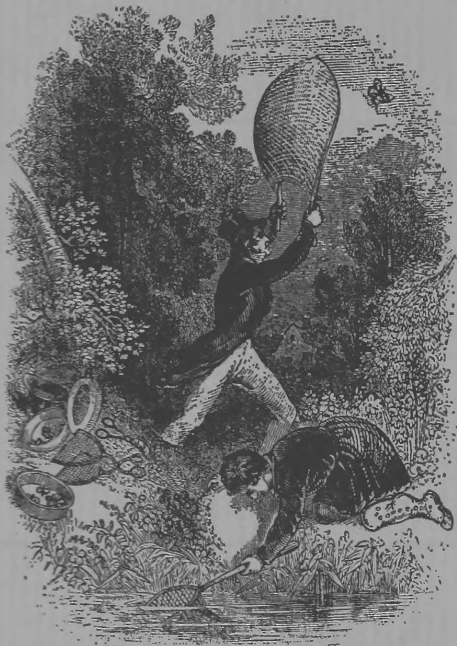

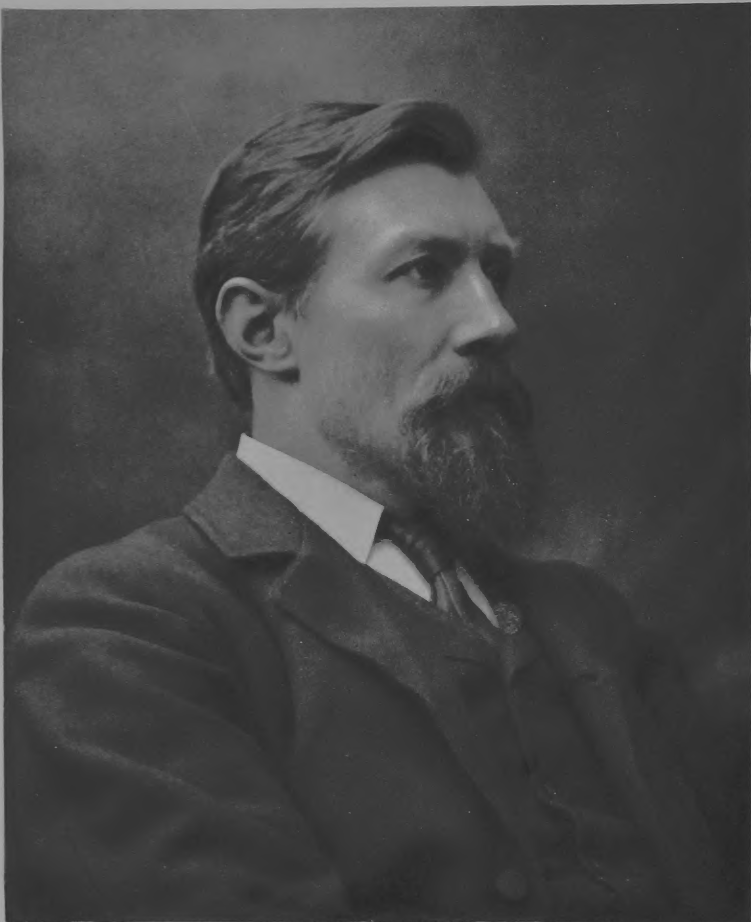

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Jas. W. Tutt

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A NATURAL HISTORY OF THE

BRITISH LEPIDOPTERA

A TEXT-BOOK FOR STUDENTS AND COLLECTORS.

BY

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VOL. IV.

(With Synopsis of Contents of and General Index to Vols. I.-IV.)

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PREFACE.

In presenting volume iv of this work to my brother-lepidopterists, I do so with some misgivings, due to the fact that, whilst it has been passing through press, Messrs. Rothschild and Jordan have issued their large and excellent work, *A Revision of the Lepidopterous Family Sphingidae*, and have, as it were, thus brought my own limited attempt into rather poor comparison with their own wider and more comprehensive work. The scope and aim of the two books, however, though dealing more or less with the same subject, are so widely different, theirs being distinctly systematic and mine essentially biological, that one, perhaps, may be considered as more or less supplementary to the other. It has been a matter of great satisfaction to find that, in many instances, where my collaborators and I had found it absolutely necessary to make new and marked changes in the groupings of certain of the species, Messrs. Rothschild and Jordan have, quite independently, made the same changes, with the result that we found ourselves most unexpectedly in agreement with these authors on almost all points in which we had expected to encounter hostile criticism and opposition from the more conservative workers at this interesting superfamily. This, in itself, is satisfactory, and, if the British lepidopterist finds that the British species, which our immediate lepidopterological ancestors have lumped together under the generic names of *Deilephila*, *Choerocampa* and *Sphinx*, have, in most cases, not only been placed in different genera, but, in some instances, in different tribes, and even (in the case of *Daphnis nerii)* in a different subfamily, we can only urge that we are sinning in good company, and that a critical review of the Sphingids of the world has proved, quite independently to Messrs. Rothschild and Jordan and to ourselves, that the few British species, included in these genera by Stainton, Newman, Barrett and Meyrick, are really scattered representatives of widely different groups having their central areas often in districts quite outside the limits of the Palæarctic area. We feel quite satisfied, therefore, with our results in this direction.

There is, however, one point of difference between these authors and ourselves which is most unsatisfactory. This is the difference in the results arrived at in our attempts to grapple with the question of generic nomenclature. Whilst they and we both claim to have been guided by the strict law of priority in this matter, we have arrived, in many cases, at totally different results, and, whilst we are agreed for example that *gallii*, should be, by the strict law of

priority, called *Celerio gallii*, *populi*—*Amorpha populi*, *tiliae*—*Mimas tiliae*, and so on, yet Messrs. Rothschild and Jordan term the species we call *Hemaris fuciformis*, *Haemorrhagia fuciformis*, the species that we call *Sesia stellatarum*, they know as *Macroglossum stellatarum*, and these differences are only typical of many others. These divergences arise from three causes: (1) The entirely different way in which we select the types of the various genera. (2) The subdivision of certain genera by one held to be inseparable by the others. (3) The rejection by these authors of Hübner's *Tentamen*, which they urge contains only "nomina nuda." Their mode of selection of the type of a genus is easy if not scientific, for they consider the species placed in the first position in the genus by the author, the type, whether or not such species agrees with the diagnosis of the genus, or whether the species was or was not known to the author. There is much to be said for this mode of selection of a type, for the most ignorant lepidopterist can do it as satisfactorily as the most learned, it does away with the need of either knowledge or brains, and the type-fixer need not determine which species of the genus were really before the author when naming the genus, nor which species were afterwards added by him as possible members of his genus from descriptions or the examination of the figures of other authors, the species being unknown to him in nature. Neither does he need to trouble himself about the action of the original author's successors, nor consider their work. By this amazing method *ocellata* becomes the type of Linné's genus *Sphinx*, although Linné himself shows us that he obtained the name from Réaumur and intended it specially to apply to *ligustri*. The "Merton Rules" insist that the "type" of a genus must not disagree with the description of the genus, and shall be considered as that species on which the generic diagnosis was essentially or mainly based, so far as is compatible with an acceptance of subsequent revisions, in their chronological order—which is the only true "law of priority." This appears to us both sound logic and commonsense. It requires, of course, in most cases, knowledge and intelligence to settle these points, and it follows that the type can only be determined by those who know. It is true that the fixing of the type by this means is not automatic, it may lead to difference of opinion and, therefore, has drawbacks. Without wishing to defend the method adopted further, we will only add that, with the publication of the "Merton rules" we had hoped that the workers at the British Museum and our leading lepidopterists would have been guided by their principles and a large measure of uniformity attained. Vain hope! Every lepidopterist who has reached a certain standard of work, knows how to construct rules that shall lead to uniformity better than every other lepidopterist, and the result is that almost everyone has his own independent method. To us the whole matter appears egotistical; at least the leading British workers could readily agree to an uniform code, but, evidently, whilst everyone cries aloud for an uniform nomenclature, the criers take every possible precaution not to get it. Those differences that arise from a subdivision of genera, the natural outcome of a close study of the species involved, are of much less importance, for they are largely the result of the

personal predilections of the author, *e.g.*, we maintain the *Hyles (euphorbiae)* group as generically distinct from the *Celerio (gallii)* group, &c., but such differences are readily dealt with as they involve no real divergence of practice by the authors. The question of what have been termed generic "nomina nuda," *i.e.*, generic names without description, is on quite a different footing. Hübner, in 1796, figured *populi*, as *Sphinx populi*. In 1806, he published a scheme of classification, known popularly as the *Tentamen*, one of the original copies of which is in our possession, and an exact verbatim copy of which is published in the *Entom. Record*, &c., xiv., pp. 167-168 (and which he afterwards worked out, with modifications, in his other works at length), in which, among others, he proposed *Amorpha* as the generic name of *populi*, *Manduca* as the generic name of *atropos*, &c. To assert that *Amorpha* is a "nomen nudum" appears to us quite untenable since it was defined by its reference to *populi* (already figured by the same author) as the type. It appears to us to be a much more clearly defined generic term written simply—*Amorpha populi*—than does Linné's *Sphinx* defined as—"Antennæ medio crassiores s. utraque extremitate attenuatæ subprismaticæ. Alæ deflexæ—*Ocellata, populi, tiliae, nerii, convolvuli, ligustri, atropos, celerio, euphorbiae, tantalus, stellatarum, culiciformis, filipendulae, phegea, statices*," and many other heterogeneric species. Our authors say that "Every name is a term for a definition." If this be so, is the name *Amorpha* less satisfactorily defined by simply citing *populi* to it, than is *Sphinx*, described in such a way that *atropos* and *statices* are included in it? The fact is, the names of the older authors must be used with commonsense and in the light of our knowledge of the work of the authors; the work of Linné shows us that he looked upon *ligustri* as the typical *Sphinx*, we know that Hübner looked upon *populi* as the typical *Amorpha* and *atropos* as the typical *Manduca*. This excursus will perhaps be held by some to form an excellent illustration of the rapid approach we appear to be making to an uniform code of nomenclature that shall be accepted by all lepidopterists!

To meet the criticism offered on our last volume, that we had ourselves in some cases used generic "nomina nuda," and that descriptions of these were advisable to save them from being sunk by those who disagreed with our action in using such, we took steps to have this matter rectified by describing them in the February no. of *The Entomologist's Record*, 1903, pp. 42-43; whilst, as it had already become necessary to found and use new generic names in our progress through the present volume, these also were described in the March and April numbers of the same magazine (*op. cit.*, pp. 75-76, pp. 100-101). About a week after the latest of these descriptions had appeared, the *Revision of the Sphingidae* was published, when we found that we had unknowingly and unfortunately forestalled some of the new generic names that Messrs. Rothschild and Jordan had therein created, *e.g.*, *Clarina*, Tutt, *Ent. Rec.*, xv., p. 76 (March 15th, 1903) forestalls *Berutana*, Roths. and Jordan, *Revision, &c.*, p. 519, April 21st, 1903), etc. One or two others are in like case, and our names must in these instances stand. In that part of our book (from p. 297 to end) printed after the publication of the *Revision*, we have, of course, utilised Messrs. Rothschild and Jordan's

new genera wherever available.

There is one point in particular, out of many others, in which the work of these authors far surpasses our own, and that is in their mode of treatment of the variation of the species. Their own immense collection, the visits paid by Dr. Jordan to all the leading collections on the continent, the loan of types from outlying countries, &c., have permitted them to attempt to deal with this phase of the subject on general biological grounds, and, in some cases, they have thus been enabled to discriminate between the "literary" type and the "biological" type, and, having determined the latter, so far as the material allowed, have arranged the various forms round it according to their assumed phylogenetic connection therewith. For ourselves, our material has been too small and our knowledge too limited to enable us to attempt anything so extensive. Nor must we forget to draw attention to their comprehensive scheme for separating the various forms, but their reasons for changing the well-known term "aberration" to "individual variety" and "variety" to "subspecies" appear to us altogether unconvincing. To assume that, because ignorant and careless lepidopterists make an erroneous use of existing terminology, reason is shown for changing the terminology, appears to us unwarrantable. In our more ignorant days we misused the terms variety and aberration, over and over again, and maintained this misuse throughout the whole of our work, *The British Noctuae and their Varieties*, but to assume that a different terminology would have abolished our ignorance is at least open to question.

Other points arise out of this view of our subject, one of which is that in which these authors gird at those who, like ourselves, have adopted the Superfamily, Family, Subfamily, Tribe, Genus and Species, as the various group names for classification. They claim that these are too numerous, that the Family and Superfamily should be united as the Family, and the Subfamily should be the second term of the series. It is humorous, however, to find them calling the Superfamily *Sphingides* the Family *Sphingidae*, then dividing their Family into Sections A *(Sphingidae asemanophorae)* and B *(Sphingidae semanophorae)* and subdividing A and B in due course into subfamilies. The fact is that their method differs in no respect from ours; it is only a matter of terms, in which the classificatory categories compare as follows:

Superfamily	Family
Family	Section of Family
Subfamily	Subfamily
Tribe	Tribe
Genus	Genus
Species	Species
Variety or local race	Subspecies or Geographical variety
Seasonal variety	Generatory variety
Aberration	Individual variety

The authors claim simplicity for their method (2nd column) over ours (1st column); we can only urge that if their method is the more simple it is less lucid. We are unfortunate in not even seeing its claim to simplicity; for ourselves, it looks much like putting a premium upon ignorance. Unfortunately, human

ignorance is rarely, if ever, convinced with anything that attempts to lead it by easy stages to a higher level, and we have little hope that the entomological collector will be raised to a more exact method of description by calling a "variety" a "subspecies," an "aberration" an "individual variation," a "superfamily" a "family," and a "family" "Section A or B" as the case may be. Nor do we see the reason for the alteration of the generally accepted tribal termination "idi" for "icæ," a change that makes neither for greater uniformity nor simplicity. With their sinking of the "subgenus" we quite agree; if it is to be held, as they (and we) hold, that "the genus is the classificatory unit one category higher than the species and comprising one definable group of species," then a subgenus has no place; in its present use by authors the subgenus replaces the genus, the genus the tribe, and so on, the result simply being an application of terms to groups differently called by almost all other biologists, and hence making for confusion.

These are the main points which a careful study of Rothschild and Jordan's magnificent work suggests to us are in need of explanation, showing how the differences between their work and ours have arisen. The wisdom of sinking a large number of well-differentiated, and what have hitherto been held as clearly distinct, species as varieties, is not for us to judge; we have insufficient knowledge to deal with the matter.

It will be seen that the arrangement of our "Catalogue," at the end of this volume, differs considerably from the order adopted in our work. During the progress of a work of this magnitude the author is always having, as it were, to consider fresh facts that modify his earlier judgments, formed on less material, and to make this change clear to his readers. In fact, he educates himself by his work and is really only fitted to commence the writing of his book when he concludes it. If one carried out this mental attitude to its logical conclusion one suspects that no book would ever be written, for, as it is a plea for perfection, and nothing perfect from this standpoint can exist, it follows that each successive stage of work would only lead to the desire for a better. This is only put forward as a plea for lenient consideration of the many imperfections and illogicalities that will be self-evident to every serious student as he follows our work, and as a means of adding that the order of the Catalogue, so far as a linear order means anything, represents a somewhat maturer view than the order of the book itself.

To my collaborators, I desire to express my unqualified thanks —to Dr. T. A. Chapman, Messrs. A. W. Bacot, W. J. Kaye and L. B. Prout my very best thanks are due. The references to their work will show how greatly I am indebted to them, whilst the kind help of Messrs. G. C. Bignell, C. R. N. Burrows, J. C. Dollman, W. F. Kirby, A. Sich, and others, must not pass unacknowledged. I had hoped that the book would have been published some months since, but various contingencies, mainly relating to printing, have delayed the work till almost the end of the year before completion. Still, I trust now that it is completed, it will meet with the approval of all those serious students of lepidopterology who are generous enough to support my work.

It has been continually urged, by Mr. Bateson and others, since

the publication of the 1st volume, that an extensive "general index ought to be printed in addition to the long "special" index provided with each volume, to make the contents more readily available to the generalising biologist. In response to our offer in the preface to volume iii to print such an index should any lepidopterist be willing to compile one, our friend the Reverend George Wheeler, M.A., kindly offered to do so and we have great pleasure in adding his excellent contribution to our work to this volume. We have no doubt the labour involved will be fully appreciated by those biologists who use the work seriously.

Whilst we regret that our subscription list meets with no better support from the British lepidopterist, who appears often to be unwilling to extend his knowledge in the direction indicated in these volumes, we have to thank that ever-increasing number of supporters who purchase the work through the publishers and without whose active aid the publication of the work could hardly be seriously persisted in. At the same time we do most heartily thank those who do subscribe and thus enable us to produce a work which even the Continental lepidopterists recognise has a much wider scope than its title would indicate, and which it has already been suggested in the German magazines should be translated into that language for the use of German lepidopterists. One cannot believe that a work, essentially British in its conception and main outlines, can be of greater value to German lepidopterists than to those for whom it has been primarily written. We trust that all those who have the work will find as great pleasure in studying it as the author has had in writing it.

The subscribers who have been added to our list since the publication of the last volume are :—

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The knowledge that no one man can bring to a successful issue so comprehensive a task as the completion of this work, leads us to state that, if any well-qualified lepidopterist with sufficient leisure feels inclined to prepare any one of the proposed future volumes, on the same lines as those published, we should be pleased to hear from him. It might be possible for us to collaborate and to take the responsibility of publication of such a volume (or volumes) and we would suggest that the Tortricids, the Noctuids, the Adelids, the Tineids *(in sens. strict.)*, Pyralids, Crambids, and Geometrids are among the groups a thorough overhauling of which is highly desirable.

PRESS NOTICES OF VOL. III.

"Nous venons de recevoir le troisième volume du grand ouvrage de J. W. Tutt, sur les Lépidoptères Britanniques, *A Natural History of the British Lepidoptera*. Le succès obtenu par l'apparition des deux premiers volumes a été tel que le troisième était attendu par tous les naturalistes sérieux avec une vive et légitime impatience. L'attente n'a pas été déçue; comme ses deux devanciers, ce livre est d'une inappréciable valeur et d'un intérêt scientifique immense au point de vue de l'étude des Lépidoptères; il est appelé à rendre de précieux services à tous ceux qui désirent pousser très loin l'étude biologique des papillons. C'est certainement l'ouvrage le plus complet qui a été écrit sur la matière jusqu'à ce jour; il crée comme une nouvelle orientation Ce livre prendra rang parmi les œuvres des plus grands maîtres de l'entomologie. Cet ouvrage de 558 pages, d'un texte très serré, est entièrement consacré à l'étude de treize espèces de papillons nocturnes anglais (qui sont également de Belgique). c'est donc une moyenne de presque 43 pages de texte pour chaque espèce. . . . Tutt ne se contente pas de donner l'histoire naturelle complète des espèces qu'il traite, mais il y ajoute la description originale, la synonymie entière du genre et de l'espèce, les localités d'Europe où ces espèces ont été signalées. Outre ces renseignements. il donne encore, après chaque famille, un catalogue des espèces paléarctiques, ce qui fait de son livre une véritable bibliothèque entomologique. L'étude des variétés et aberrations est aussi parfaite qu'on peut l'espérer; l'auteur rencontre et décrit toutes celles qui ont été signalées tant en Angleterre que sur le continent. Il est intéressant de donner un petit aperçu de la manière dont l'ouvrage est composé. Après avoir traité de main de maître tout ce qui se rapporte aux Familles, Tribus, Genres, etc., le savant auteur attaque l'espèce sous tous ses états. sous toutes ses formes—imago, dimorphisme sexuel, gynandromorphisme, variation, ponte, œuf, mœurs de la chenille, comparaison de la chenille, avec celles des espèces voisines, métamorphose. cocon, chrysalide, déhiscence de la chrysalide, parasites. plantes nourricières, mœurs et habitat du papillon, époques d'apparition. localités, distribution géographique. etc. Après ceci on peut se demander ce que les auteurs futurs pourront ajouter à l'histoire naturelle des Lépidoptères. Rien, si ce n'est débrouiller le terrible problème de l'origine des espèces et des variétés. Quelle somme de travail il a fallu pour écrire un tel livre, que d'auteurs il a fallu consulter, que de renseignements il a fallu demander aux naturalistes de tous les pays! Nous voudrions voir cet ouvrage dans les mains de tous les lépidoptéristes de notre pays; ce serait une récompense et un encouragement pour l'auteur de cet immense et utile travail. Puisse notre savant collègue être à même de faire paraître sans retard son quatrième volume qui est attendu avec autant d'impatience que les trois premiers, et puisse-t-il voir l'achèvement et le couronnement de son œuvre."—L. J. L. LAMBILLION. *Revue Mensuelle de la Société entomologique Namuroise*. November, 1902.

"Die dem vorliegenden 3 Bande vorbergebenden Volumina dieses bedeutsamen Werkes, welches—man kann wohl sagen—alles Aehnliche in den Schatten stellt, enthielten ausser dem sehr ausführlichen allgemeinen Teil über den Ursprung der Schmetterlinge, Embryologie, Parthenogenesis, Variation, Schutzfärbung der Imago, Metamorphose, Morphologie, Phylogenie der Puppe etc., den Anfang des ersten Stammes (Stirps) des vom Autor aufgestellten und ausführlich begründeten Systems. die *Sphingo-Micropterygiden*. Der 1 Band (1899) behandelte die Superfamilien: *Micropterygiden*, *Nepticuliden*, *Cochlididen* und *Anthroceriden*. Den Anfang macht also eine Familie, welche bisher an den Schluss der "Micro"-Schmetterlinge (es sei mir gestattet, den Ausdruck zu gebrauchen) gestellt wurde, eine weitere Kleinschmetterlingsfamilie schliesst sich an und es folgen die unter der Bezeichnung *Limacodiden* und *Zygaeniden* geläufigeren beiden. nach bisherigen Begriffen recht entfernt von einander stehenden Familien. In Band 2 (1900) erscheinen *Psychiden* und der Anfang der *Lachneiden (=Lasiocampiden)*. Zu ersteren werden einige Gattungen der *Tineiden* und *Talaeporiden*. (Kleinschmetterlinge) gestellt, eine Neuerung, die im besonderen ebenso umwälzend wirkt. wie das System im allgemeinen. Bei den *Lasiocampiden* erscheint inmitten eine bisher zu den *Notodontiden* gezählte Gattung (*Nadata*). Band 3 bringt den Rest der *Lachneiden*, die *Dimorphiden* (*=Endromididen*), *Bombyciden*, *Attaciden*, und den Anfang der *Sphingiden* nebst einer Uebersicht der palaearctischen *Lachneiden*. — Als ein Factor zur Beurteilung der Gründlichkeit des Werkes mag gelten, dass in dem Bande von 558 Seiten nur 13 Arten Lepidopteren behandelt werden, wenn auch auf die allgemeine Systematik der Superfamilien Gruppen, Familien, Subfamilien, Tribus und Genera ein nicbt unbedeutender Raum entfällt. Die Decentralisierung des Systems, so ausführlicb sie auch begründet und klar durchdacht ist, wirkt fast etwas zu erscbwerend auf das Ganze und möchte die Frage nicht unberechtigt erscheinen, ob hierzu eine dringende Notwendigkeit oder eine, dem Zwecke entsprechende Nützlichkeit vorliegt. Die Revision der einzelnen Gruppen geschiebt in des Sinnes weitester Bedeutung. Im besonderen beschäftigt sich die Systematik mit den in Grossbritannien heimischen Arten unter genauester Aufzählung alles dessen, was über die Biologie, Gynandromorphismus, Hybridismus, Verbreitung und Variation der Art überhaupt bekannt ist und spielt somit die Arbeit im Gebiete über, welche auch dem Sammler des Festlandes von ungemein grosser Bedeutung sind und welche dem Buch eine besondere Wichtigkeit verleihen. namentlich auch deswegen, weil eine ausserordentlich umfassende Litteraturcitation und Verzeichnisse aller bekannten paläarctischen Gattungen und Arten das Studium letzerer wesentlicb erleicbtern. Ebenso wie der Autor die generelle Systematik der höheren Einheiten mit einer ausgiebigen Zabl neuer Bezeichnungen, die sich im wesentlichen nur in der Endung unterscbeiden. bereichert, wird auch eine grössere Anzahl verschollener Genera wieder eingefübrt und bei den einzelnen Arten eine. man möchte sagen, mehr als ausreichende Menge neuer Aberrationsnamen aufgestellt. Ueber den Wert solcber Namen ist schon viel gestritten worden. Eine gewisse Utilität ist bei dem Prinzip, Spielarten zu benennen, nicht zu läugnen, wenn dies in mässigen Grenzen geschieht. Bedenkt man aber, dass von den Individuen einer Art kaum eines dem andern völlig gleicht, und wollte man jede Farbenabänderung oder von dem Typus in sonst einer Weise gering abweicbende Form benennen. so dürfte dies zu weit führen und bei dem Sammler einen Grad der Mnemotecbnik erheischen, der weit über der Grenze des Geistes eines Durchschnittsmenschen liegt. Schlagen,

wir z. B. p. 227 des Buches auf: Wir finden im Index unter. *Macrothylacia (Bombyx) rubi*, L., sage und schreibe 43 Aberrationen auct. Tutt. Das dürfte genügen und den Autorgelüsten anderer Entomologen oder Entomophilen ein für alle Mal einen Riegel vorschieben. Diese Methode der Namensgebung beweist aber andererseits wiederum, die intensive Ausführlichkeit der Arbeit, an der neben dem Autor und seinen Specialmitarbeitern (Chapman, Bacot, Prout) etwa 200 Lepidopterologen beigesteuert und zu der nur alles erdenkliche Material aus Zeitschriften und Special-Werken zusammengetragen worden ist. Das Werk verdient deswegen unsere volle Aufmerksamkeit und Anerkennung und soll die Gelegenheit nicht versäumt werden den Sammler europäischer Schmetterlinge, für den dasselbe nicht minder wertvoll als für den Briten, ja man kann wohl sagen unersetzlich ist, hierauf hinzuweisen. Der Beschaffungspreis ist,—auf die Erscheinungszeit der einzelnen Bände verteilt—ein durchaus erträglicher, und sollten es sich auch die Lepidopterologen des Festlandes, namentlich aber Institute, Gesellschaften und Vereine angelegen sein lassen, durch Beschaffung der Bücher das Unternehmen zu unterstützen und zu fördern, und wir wollen dem Autor wünschen, dass es ihm vergönnt sein möchte, das gewaltige Werk programmmässig zum Abschluss zu bringen.—H. Stichel, *Berliner Entomologische Zeitschrift*, January, 1903.

"Der dritte Band eines von staunenswertem Fleiss zeigenden Unternehmens liegt vor, neben dem sich in der ganzen lepidopterologischen Literatur nur Scudders *Butterflies of the Eastern United States and Canada* vergleichsweise nennen lassen. Durch die geradezu erschöpfende Darstellung des Stoffes überragt aber Tutts Arbeit noch das Riesenwerk des Amerikaners! Werden doch in dem vorliegenden Bande von 558 Seiten nur nachstehende 13 Arten besprochen. . . . Dieselben bilden einen Teil der Lachneiden (Lasiocampiden) die Saturniiden, Endromididen und einen Teil der Sphingiden in der britischen Fauna. Diese Breite der Darstellung wird nur verständlich wenn man sich vergegenwärtigt, dass der Stoff eine Behandlung erfährt, die weit über die Grenzen des Buchtitels hinausgeht. Die britische Fauna ist gleichsam nur das Skelet, welches diese encyklopädisch angelegte Riesenarbeit zu stützen hat. Und darin liegt auch ihre allgemeine Bedeutung. Der Besitz des Werkes, welches auch bibliographisch eine Musterleistung genannt werden muss, kann die Benützung einer Fachbibliothek, wenigstens für den Privatmann, fast entbehrlich machen. Einige Beispiele mögen zur Erläuterung des Gesagten dienen. . . . Am Schluss der Lachneiden wird eine Liste sämtlicher paläarktischer Arten mit ihren Varietäten und Aberrationen gegeben, die halbseitig gedruckt 3½ Seiten beansprucht. Die Besprechung von *Dimorpha versicolora* (S. 229-264) gleicht einer Monographie über diese interessante monotypische Gattung. In analoger Weise sind die Saturniiden und Sphingiden behandelt, deren allgemeine Systematik, vom historischen Standpunkte ausgehend, bei letzteren 40 Seiten beansprucht. Es liegt auf der Hand, dass eine solche Leistung nicht von einem Einzelnen bewältigt werden kann und in der Tat hat das Werk auch eine grosse Zahl von Mitarbeitern gefunden unter welchen wir Namen wie Chapman, Bacot und Prout finden. Nach dem Gesagten besitzt das Werk eine weit über die Grenzen Englands hinausreichende Bedeutung, ja es muss namentlich für den literarisch arbeitenden Fachmann durch seinen encyklopädischen Charakter geradezu als unentbehrlich bezeichnet werden. . . . Wenn noch einige unwesentliche Ausstellungen—gewiss ohne Schmälerung des Gesamtwertes des Werkes—hier ausgesprochen sein dürfen, so wäre es vor Allem der Wunsch nach Hervorhebung des hier Originellem und Neugebotenem, vor allem des hier zuerst Bekanntgemachten. Viele wertvolle Beobachtungen und Angaben sind als neu nicht sofort erkennbar, was bei Benützung des so breit angelegten Textes sehr wünschenswert wäre. — H. Rebel, *Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien*. July, 1903.

Apart from a host of popular handbooks, there are two works on the Palæarctic Hawk Moths worthy of special notice. These are by Bartel, in Rühl, *Grossschm.*, vol. ii., and by Tutt, *British Lepidoptera*, vol. iii. . . . Tutt's work is the most intrinsic ever written on Palæarctic Lepidoptera. The third volume comprises only a portion of the *Sphingidae;* the remainder of the family will appear in the fourth. The work will be of the greatest help to the scientist who knows the matter well enough to be able to distinguish between what is scientific and what appears merely in a scientific garb. . . . There is nothing written anywhere on European Lepidoptera coming up to it in thoroughness.—Rothschild and Jordan, *A Revision of the Lepidopterous Family Sphingidae.* April, 1903.

With remarkable and praiseworthy promptitude the successive volumes of this thoroughly scientific work are appearing to gladden the heart of the earnest worker in the most popular group of British insects, and we hardly know which to admire most, the zeal of the author in so rapidly producing the mass of information which is contained in each volume, or the thoroughness with which his work is done. Before dealing with the work more in detail, we must emphatically assert that, in our opinion, it is far and away the best account of our native lepidoptera that has ever been published; and, as much of the information relates to Scotland, both as regards distribution and variation, we cordially recommend the work to the notice of our northern entomologists. To the really scientific lepidopterist, indeed, Mr. Tutt's volumes are quite indispensable. The present volume deals with the remainder of the 6th superfamily (Lachneides) of the Sphingo-Micropterygid strips, the 7th and 8th superfamilies (Dimorphides and Attacides), and a portion of the 9th (Sphingides). The exhaustive nature of the work is shown by the fact that, in 540 closely printed pages, only 14 species are disposed of, that is, in addition to the accounts of the various genera and larger groups to which those species belong. The account of *Lasiocampa quercûs* occupies no fewer than 69 pages! The information there given is printed under the following heads:—Synonymy, original description, description of imago, sexual dimorphism, gynandromorphism, variation (39 pages), egg-laying, egg-parasites, description of ovum, comparisons of ova of different varieties, habits of larva (4½ pages), description of larva, comparison of larvæ of different varieties, pupation, description of cocoon, description of pupa, comparison of pupa with that of *Cosmotriche potatoria*, dehiscence of pupa, foodplants, parasites, habits and habitat, time of appearance, localities, and distribution (3 pages of small type). What more could the most exacting seeker after information desire? The matter, too, is so well arranged that any particular fact, under any of the heads just quoted, can be found without much difficulty. The present volume is an improvement upon the two previous ones, inasmuch as the table of contents is more extended, but we would suggest a slight additional alteration which would, we think, be acceptable to all who use the work. If in the index, the figures indicating the page upon which the *main* account of any particular genus or species *commences* were printed in bolder type, it would save unnecessary page turning. Lastly the addition of a *comprehensive* index to this and the preceding volumes would be a boon, and we are glad to read

in the preface that the author is willing to print one if carefully prepared by anyone who has the requisite time at his disposal.—P. H. Grimshaw. F.E.S., *The Annals of Scottish Natural History*, January, 1903.

"The third volume of Mr. J. W. Tutt's *British Lepidoptera* is a really important book. It has been compiled on the same plan as the preceding volumes, though partly on account of the particular genera treated, but more from the catholic taste with which the author has brought together his materials, the present work is even more useful to the scientific entomologist than vols. i and ii. To the collector and systematist Mr. Tutt's books are without doubt of high value. The analysis of specific and varietal characters is evidently made with extreme care, but, to the general naturalist, and especially to the student of evolution, the book has a direct and uncommon importance. Nothing of this kind has been attempted in any language hitherto. Mr. Tutt though modestly entitling his work *A Natural History of British Lepidoptera*, has gone much further afield than such a title would lead a reader to expect. For example, in treating *Lasiocampa quercûs*, we are provided not merely with a discussion of the British races, but an abstract is given of all that has been observed in the field or discovered by experimental breeding regarding the foreign forms and the laws which govern their heredity and variation. Again, in connection with the natural history of *Saturnia pavonia*, Mr. Tutt introduces a full account of Standfuss' important experiments in crossing the continental species. Many similar examples might be given illustrating the broad scope of the work. It may well be imagined that, in dealing thus liberally with species such as *quercûs*, *potatoria*, *pavonia*, *tiliae*, *populi* and *ocellata*, all forms famous in the literature of variation and hybridisation, a very fine body of evidence has been amassed. To take the subject of gynandromorphism alone, it is scarcely too much to say that the raw material for a treatise is scattered through Mr. Tutt's pages. The abstracting and condensation of the evidence, so far as it can be judged by one who is not a professed entomologist has been most carefully done, and the reader may feel confidence that, though the points are concisely put, exaggeration has been consistently avoided. Altogether, such a work is one to be thankful for, and there can be no doubt that such a publication will stimulate the younger generation of students to step from the narrow track of mere collecting, and to wander off into the more fertile fields of experiment and observation of living forms. Mr. Tutt tells us in his preface that if anyone will make a subject index, he will print it in the next volume. Cannot some keen young worker take him at his word? Meanwhile the student of evolution must not be daunted by the difficulty of putting his hand at once on the fact he is looking for, and the physiological *chiffonier*, as Claude Bernard calls himself, may be assured that, if he will only rummage about a little, he will pick up some rare treasures in Mr. Tutt's heap. To include everything that can by any possibility relate to, or interest the student of. the British fauna, is to err on the right side, though the connection with that fauna be rather remote. Now and again, however, we come on a few pages which are very doubtful in point. Space being so valuable, we feel that, for instance, the details regarding the structure and classification of the Attacides of the world need not have found a place here, not that the facts are unimportant, but no one is likely to look for them in a work on a fauna which contains one solitary species of the group. The unprofessional reader wonders, too, who *uses* the solid pages of locality records in the case of species widely distributed. When these records detail the varieties of the districts their value is manifest, and they will form a solid basis for the observation of future changes in distribution. Did we not feel sure that, in this case, the author knows the requirements of his public, we might be disposed to question whether this was really the best use to which the labour and space could have been put. None of these remarks, however, detract from the statement that the new *British Lepidoptera* is a fine scholarly piece of work, for which not only the entomological specialist, but naturalists of all orders, will be thankful to Mr. Tutt for many a year."—W. Bateson, M.A., F.R.S., *Entomologist's Record, &c.*, December, 1902.

"The third volume of this work has now appeared. It is of the same exhaustive character as those which have preceded it, as may be inferred from the fact that, in its 558 pages, only thirteen species are described, *i.e.*, the remainder of the '*Lachneides*' (*Lasiocampa quercûs*, etc.) *D. versicolora*, *S. pavonia*, the three species of the old Smerinthid genus, and the two British 'Bee-Hawks,' *H. fuciformis and H. tityus* (*bombyliformis*). As an example of the author's exhaustive treatment, *L. quercûs* may be cited. All lepidopterists know the vast amount of discussion that has taken place since the var. *callunae* was introduced about 1847 as a distinct species. The immense amount of information since obtained as to the habits of this species in different regions of Europe and Asia is brought together and discussed in about 80 pages, in a manner which seems to leave scarcely anything more to be said. It would be an error, however, to suppose that the volume is limited to descriptions of thirteen species, their many varieties and recorded aberrations, their life-histories, habits and localities. These, indeed, are given in very great detail; but the relations of the species found in our islands to those found in the rest of world are always kept in view, and the result is that a very large proportion of the 558 pages is devoted to information and discussions of as much interest to Continental and American lepidopterists as to our own. In this connection I would draw attention to the frequent observations on the conjectured phylogeny of the species, and of the genera, families, etc., to which they belong, and on their proper places in a classification based on the observation of the insects in all their stages. A knowledge of these is, of course, essential for this purpose, seeing the different traces of their probable origin which they bear in these stages, and the diversity of the directions in which, in these several stages, owing to the entirely different lives they lead in them, they appear to have evolved. As regards phylogeny in general, the observation at p. 359 is deserving of being well weighed. The passage is too long to quote, but it comes to this, that what we call the 'lowest' members of a stirps are as many generations from the common stock as the 'highest' are; we may construct a hypothetical ancestor, having all the generalised but none of the specialised characteristics of a group, the members of it having specialised in different directions so that no existing form can be supposed to be derived from any form now existing. I am so thankful for the great labour which has been expended by the author and his coadjutors in obtaining and recording, with the necessary accuracy required, the detailed information contained in the work, that I do not like to suggest that, if even more labour could have been given, the value of the work might have been greater still. But when I find that such a common and widely distributed species as *C. potatoria* has more than five closely printed pages devoted to dates and localities of capture in the British Isles, I cannot help thinking that a compressed and classified summary, which need not have occupied more than half a page, would have been preferable. There are other cases also in which it appears to me that compression and condensation would have been usefully employed. Even if

Mr. Tutt agrees in this opinion, his answer might be that of the accomplished letter-writer who accounted for the length of his communication by saying that he had not time to write short; if this be so, it is greatly to be regretted, and one is all the more glad that he has had, and will we hope for the succeeding volumes have, the valuable co-operation of such excellent and thoughtful observers as Dr. Chapman, Mr. Bacot, and Mr. Prout, whose aid he acknowledges so heartily."—F. Merrifield, F.E.S., *The Entomologist's Monthly Magazine*, November, 1902.

"It is pleasant to be able to review such an eminently satisfactory book as is the third volume of 'British Lepidoptera.' Its predecessors were very welcome, but to a large number of entomologists the mass of material relating to the 'Micros' was probably unread, and thus a large portion of volumes i and ii, appeals only to a limited number. This third volume, therefore, should find more support, as the species treated of are all very well known to the great majority of collectors. The minutiæ inevitably involved in such an undertaking are again manifest, and with what effect they have been utilised it is for each individual to judge for himself. It is strongly to be hoped that the necessary increased support will be forthcoming, and that many more numbers are in store for us. The superfamily Lachneides is continued, and the first species treated is *Pachygastria trifolii*, which occupies exactly thirty pages. Following this comes the species that has doubtless caused more research and taken up more time than any hitherto already done, *viz.*, *Lasiocampa quercûs*. Preceding the description and all that follows concerning the life-history of the type and its numerous forms and varieties, is a summary of the experimental work in the hybridising of the different local races. Although nominally we have no chapter to commence vol. iii, this summary of hybridisation is a very good substitute, and has as much general interest as any such that has appeared in the previous volumes. By the time the 'Times of Appearance,' 'Habits,' 'Localities,' etc., have all been worked through, eighty pages have been covered over this species alone, and it is doubtful if anything of any moment concerning this insect can have escaped Mr. Tutt's attention. Passing on to *Macrothylacia rubi* and *Cosmotriche potatoria*, perhaps one of the most interesting collection of facts is to be found in the diversified character of the habits of the larvæ of these two species. To the former as much as five and a half pages are alone given to this part of the scheme. *Gastropacha ilicifolia* comes in its turn, with full descriptions of larva, cocoon, pupa, food-plants, parasites, and so on, and the collector will doubtless read with avidity the 'Habits and Habitat' section. Under *Dimorpha versicolora* the question of its allies is freely discussed and the reader is referred back to vol. i., pp. 124-125, and vol. ii., p. 440, for further discussion. One cannot help wishing, however, that the author would point out where (when possible) the imaginal characters are in agreement with the biological ones in assigning, or helping to assign, a position to a subfamily. The larval and pupal habits under this species are again full of interest, and cannot fail to engage the attention of both student and collector. At p. 265 the superfamily Attacides is brought under review. In the preface the author says he is entirely dissatisfied with his knowledge of the relationships of the various families of the Saturniides (Attacides) *inter se*, of those of the Sphingides *inter se*, and of these two superfamilies to each other. It, however, cannot be that he has not probed deep enough, for the thirty pages or so, before our only British Attacid (*Saturnia pavonia*) is treated, require the closest attention of the reader. The very thorough examination and diagnoses of the characters afforded by the larvæ of the Attacides will call for time and thought for full digestion. From p. 342 to the end of the volume the classification and position of the Sphingides are discussed, and the complete natural history of the British species of Amorphinæ and Hemarinæ recorded. Starting with Linnæus, and working through Fabricius, Scopoli, Lamarck, Latreille, Hübner, Laspeyres, Oken, Leach, Dalman, Ochsenheimer, Swainson, Boisduval, Stephens, Curtis, Duponchel, Duncan, and Westwood, a very complete review is given of the generic synonymy of the British Sphingids, and at the close a list of the types of the genera deduced is set forth. Another long diagnosis is given to the history of the superfamily, and starting with Réaumur, the works of Hübner, Stephens, Grote and Robinson, Butler, Herrich-Schäffer, Meyrick, Poulton, and Dyar, are all brought under the focus in the order given. On pp. 365-366 is a scheme, drawn up by Bacot, for separation into genera, based on larval characters, and closely following is a family and subfamily division proposed by Chapman. Concerning the latter, one notes that the Sesiinæ are only separated from the Eumorphinæ by the tufts to the abdomen, a character that certainly does not hold good throughout. Perhaps, in vol iv, some better character will be furnished when the true Macroglossids come to be reviewed. The high specialisations of larva, pupa and imago are fully discussed. The details concerning the pupa offer food for reflection, both as regards the proboscis-casing and the varying position of the glazed eye, which latter, if we are not mistaken, is brought forward for the first time. We have descriptions given of all the different hybrids produced in the Amorphinæ, not the least interesting being the comparison between the hybrids produced by *Amorpha populi* and *Smerinthus ocellata*, and hybrids from *Amorpha austauti* and *Smerinthus atlanticus*. A very complete classification of the forms and aberrations of *Mimas tiliae* is to hand at p. 404, and the same long lists of localities are given, showing in many cases unsuspected curtailment or otherwise in the range of distribution. On reference, for instance, to *Hemaris fuciformis*, it is noted as 'exceedingly rare, if not entirely absent, in Scotland and Ireland.' No one, after this, will deny that these extended lists serve a purpose other than that for the collector. In conclusion, there is only one matter we really regret, and that is that we have had to wait two years for the present instalment. It is pretty certain, however, that the book is all the more complete.—W. J. Kaye, F.E.S., *The Entomologist*, December, 1902.

"After an interval of but little more than two years, we have again the pleasure of reviewing another volume of Mr. Tutt's enormously laborious and comprehensive work on the British lepidoptera. The size and the manner of execution are similar to the two preceding volumes; but it is entirely systematic, as no space could be spared for chapters on general subjects, and perhaps, as a consequence, vol. iii contains no illustrations. We are glad to see that Mr. Tutt has adopted a suggestion made by some of his critics, and has given a somewhat fuller table of contents, which will much facilitate the use of the book. . . . . Volume iii contains the continuation of what Mr. Tutt calls the 'Sphingo-Micropterygid Stirps,' and includes the *Lachneides*, *Dimorphides*, *Attacides*, and part of *Sphingides*, the entire volume being devoted to 13 species only, *viz.*, *Pachygastria trifolii*, *Lasiocampa quercûs*, *Macrothylacia rubi*, *Cosmotriche potatoria*, *Gastropacha ilicifolia*, *Eutricha quercifolia*, *Dimorpha versicolora*, *Saturnia pavonia*, *Mimas tiliae*, *Smerinthus ocellata*, *Amorpha populi*, *Hemaris fuciformis* and *H. tityus*. Of course, every species will not require to be treated at the same length as *Lasiocampa quercûs*, which occupies (as a species) no less than 69 of Mr. Tutt's closely-printed pages, but we tremble to think of the number of volumes

and the number of years which will be required to deal with over 2000 species of British lepidoptera on the same scale. . . . Turning to more general matters, the abstracts given of different systems of classification of groups, often taken from old or scarce books, will be most useful to all students who have not access to the best entomological libraries. Mr. Tutt seems to aim at making his book a huge compendium and cyclopædia of all that has been published on the species of which he treats; and it will be of great value to generalising entomologists, who will be able to sift from it a great amount of valuable information in furtherance of their special studies. A large amount of information is given respecting foreign species, especially those of continental Europe and North America; and also on parasites, and various other subjects incidentally connected with the main subject of the work. We are sorry to find that there is only a meagre list of new subscribers since the last volume; but, as the work is necessarily too costly for many entomologists, and must become increasingly so with the publication of each volume, we would wish to emphasize its great value as a book of reference for public Natural History or Entomological Libraries, especially at a distance from London or the University towns which alone possess full series of the books of which Mr. Tutt's work is largely an abstract - not that we do not also fully recognize the large amount of material due to the original observations of Mr. Tutt and his coadjutors, which is published here for the first time.—W. F. Kirby, F.L.S., *The Annals and Magazine of Natural History*.

"The 3rd volume of Tutt's *British Lepidoptera* has appeared, and is fully up to the standard of the first two volumes. The superfamily *Lachneides* is completed, the superfamilies *Dimorphides (Endromides)*, *Attacides*, and a part of the superfamily *Sphingides* are finished. The references to literature, ancient and modern, seem to leave nothing more to be desired in this respect; in fact, the amount of labour performed and research that has been made seems almost appalling, and we wonder whether the author has the strength and endurance to carry such an undertaking through to completion. This work may well be taken as a model by one who is less experienced, provided he does not follow it too closely and thus destroy his own originality of thought and plan. Under each superfamily is given a very complete history of the classifications of the different authors. These are carefully discussed, and when the author differs from others he does not hesitate to express his convictions. Many of our old familiar names have disappeared, and are to be found only among the tail-feathers of synonymy. This is, however, strictly in accordance with the law of priority, and if any of us feel unreconciled to this, we may well ask ourselves whether we are to keep up with the trend of modern scientific thought or fall by the way. Under each species is given the synonymy and references to literature, so full and complete that we can hardly imagine anything of importance to have been overlooked. Then follows the original description in the language in which it was published, and this is followed by the author's description of the imago. There is then given a full account of sexual dimorphism and gynandromophism more than 5 pages being devoted to gynandromorphous examples of *Amorpha populi*, L.). Variation is also taken up very fully with all the forms described and named, and this requires 7 pages for *A. populi* alone. A complete account is given of the time, place, and manner in which the eggs are laid, followed by a full description of the egg, the larva in each stadium, and variations of the larva, pupation and cocoon, pupa, foodplants, parasites, habitats, time and place of appearance and distribution. While this work must prove indispensable to the entomologist who desires full information on the lepidoptera of the British Isles, it will be exceedingly valuable to students of the lepidoptera in the United States and elsewhere, because of the exhaustive study of the literature of the genera, and higher groups, and the careful and conscientious manner in which the author applies the laws of nomenclature."—C. H. Fernald, M.A., Ph.D., F.E.S., *The Canadian Entomologist*, January, 1903.

"Two years after the publication of the second volume, the third volume of *British Lepidoptera* has been completed. It differs from its predecessors inasmuch as it is not divided into two parts, but deals throughout with the species continued from vol. ii. The first species dealt with is *Pachygastria trifolii*, the last *Hemaris tityus* (*bombyliformis*). One has little doubt that, of all the species dealt with, *Lasiocampa quercûs* will come in for the most notice. The history of this species occupies no less than 70 pages, much of it is in small type, and the whole composed of summarised detail dealing with facts, and without a word that could possibly be spared. Little that has ever been published on this interesting species can have escaped the search-net, and the full details of the variation will not only prove of the highest interest to all students and collectors of lepidoptera, but the critical onslaughts made on the misuse of the varietal names on the continent will necessitate a thorough study by continental lepidopterists. Short notes on *Lasiocampa* var. *callunae*, often repeated *ad nauseam* with no fresh facts or details, and stating simply what has been published so often before, by recruits who are for ever finding out something quite new because of their ignorance of previously published matter or their inability to find it, must of necessity be fewer in number or more scientific in character now that the details (pp. 73-85) so industriously collected by the author can be so readily studied, for these pages do not represent the author's opinion of the subject, but the opinions and facts of all lepidopterists who have handled the subspecies since 1849, when Palmer first described it. To many the account of *Dimorpha versicolora* will be especially welcome, consisting as it does of 35 pages (pp. 229-264) of solid matter relating to this interesting species, and embodied in which one finds descriptions of no less than ten striking gynandromorphs, a complete life-history based on the observations of Chapman, Bacot, Holland, Clarke, Gascoyne, Merrifield, Buckler, Bernard-Smith, Poulton, Jenvey, Bankes, Tugwell, etc., whilst more than a hundred other lepidopterists are quoted for details relating to localities, dates of appearance, habits, etc. As a matter of comparison, however, it may be noted that *Gastropacha ilicifolia* has been worked out in such detail as to require from pp. 186-199 to describe it and its habits in their various aspects, and practically every detail of our knowledge of the species in Britain is here embodied, as well as a complete life-history never before published. The less than a dozen lines of Newman on *Hemaris tityus*, with at least two glaring errors, become here some twelve solid pages of detailed facts, checked with the authorities and vouched for by their names. These two species are those that occupy the least space; the other species are worked out in the same careful manner, but with more facts and details. To the biologist the extensive details relating to the hybridity, gynandromorphism and life-histories of the species treated, will prove a mine of information. The account of *Smerinthus* hybr. *hybridus* (pp. 448-459) is of the greatest value as a summary of all the work published on this best known hybrid form; but the details on pp. 391-395 will prove no doubt of still more interest.

Tbe description and account of *Mimas* bybr. *leoniae*, a cross hetween *Mimas tiliae* and *Smerinthus ocellata;* of *Calasymbolus* hyhr. *interfaunus*, a cross hetween a ♂ of tbe American *Calasymbolus astylus* and a ♀ of the European *Smerinthus ocellata;* of *Smerinthus* bybr. *oberthüri*, of *S.* hyhr. *fringsi*, *Amorpha* hybr. *metis*, and *A.* hybr. *inversa*, are full of interest, whilst on pp 291-294 are the details of numerous Attacid crossings, and on pp. 296-304 a full summary of the crossings of the allied European Saturnians ; there is no need to state that full accounts of the crossing experiments of *Lasiocampa quercûs* and its various races are also given. The details relating to gynandromorphs are most interesting. Scarcely a species that is here treated but has given some examples, and when one notes no fewer than 32 gynandromorphs of *Lasiocampa quercûs* described, 60 of *Saturnia pavonia* and 80 of *Amorpha populi*, hesides smaller numbers of other species the biologist will recognise that he has here an ahundance of material on whicb to work. The Britisb collector will turn with the greatest satisfaction to Chapman's comparison of the life-histories of *Amorpha populi*, *Mimas tiliae* and *Smerinthus ocellata*, and the author's grouping of the Amorphids should at least flatter the vanity of the City of London Entomological Society, wbich one knows he loves so well. The names of Messrs. Sich, Burrows, Kaye, Dadd, Bell, Nicholson, and Clark are all laid under contribution for new genera, and no doubt other memhers' names are only missing because they have been previously utilised. To tbe systematist there are four chapters that will require time, thought and digestion. Firstly the account of the family *Eutrichidae* (pp. 111-123). Secondly, the study of the position of *Dimorpha (Endromis)* (pp. 229-236). Tbirdly, the classification of the Attacides, a detailed account of all the work done in this direction (pp. 265-290); and lastly the exhaustive chapter on tbe literature, synonymy and classification of the Sphingides (pp. 342-382). Much internal evidence shows that the author hopes to attract criticism on this part of his work, and his preface tends also to point in the same direction. As to this, the final conclusion of the autbor on tbe actual types of the genera he uses may he worth quoting . . . . It is of no use after tbis for the British collector to cavil at the change of names ; here he has the whole literature of the subject at disposal so tbat he can form his own opinions, and the author himself provides the material on whicb such may challenge him if tbey disagree with his conclusions. 'Tbe Catalogue of the Palæarctic Lachneides' (pp. 225-229), and the 'Catalogue of the Palæarctic Dimorpbides, Bombycides, Brahmæides and Attacides,' will prove of the utmost use to workers both in tbe Palæarctic and Nearctic regions, although prohahly for matters of space the species of the latter district bave been excluded. The author asks for a full measure of support from all lepidopterists. He especially appeals to American lepidopterists to support the work, claiming that the volumes bave a wider basis than their title would suggest, and pointing out that the basis of work is general, and, tberefore, of as much importance to American as to European lepidopterists."—*The Entomologist's Record*, October, 1902.

"Ein englisches Werk, das der Aufmerksamkeit auch der deutschen Naturforscber und besonders der Schmetterlingskundigen empfohlen zu werden verdient, ist 'J. W. Tutt's Natural History of the British Lepidoptera.' Dasselhe ist nach den Mitteilungen des Verfassers auf vier Bände berecbnet, von denen die drei ersten hereits erschienen sind. Das Buch ist mehr, als sein Titel besagt; es beschränkt sich nicht auf die hritischen Schmetterlinge, sondern zieht alle mit ihnen verwandten Arten und Varietäten, wo immer sie vorkommen mögen, üherhaupt alles, was mittelbar oder unmittelbar mit dem Thema im Zusammenhange steht, in den Bereicb seiner Betrachtungen. Das Werk nimmt aber auch überall Rücksicht auf allgemeine Fragen. So widmet der erste Band 112 (von seinen 560) Seiten eingehenden Erörterungen über: 1. Ursprung, 2. Ei, 3. Emhryologie, und 4. Parthenogenesis der Lepidoptera, 5. äusseren, und 6. inneren Bau der Schmetterlingslarve, 7 Variation der Imagines, 8. Schutzfärhung und Verteidigungsmittel der Larve, 9 Klassifikation der Schuppenflügler. Hierzu kommen im zweiten (584 Seiten starken) Bande 100 Seiten Betrachtungen üher: 1. Metamorphose der Lepidopteren und 2. zufällige Erscheinungen dahei, 3. äussere Morphologie und 4. inneren Bau der Schmetterlingspuppe, 5. Ahstammung der Lepidopteren (mit Stammhaum). Auch der dritte Band bringt üher biologische und andere Fragen (Hybridismus, Gynandromorphismus, Variation, Entwicklungszustände, Metamorphosen usw.) eine Menge Details, eine Anhäufung von Material, das anderswo grossenteils üherhaupt nicht zu erhalten ist, und in einer so erschöpfenden Vollständigkeit, wie sie bisher noch in keinem der einschlägigen Werke erreicht worden ist. Dieser Inhaltsreichtum giht dem Schmetterlingsforscher stete Anregung, seinen Untersuchungsgegenstand von allen möglichen Gesichtspunkten aus zu studieren, sich unablässig eine vollständige Erforschung der Insektenwelt angelegen sein zu lassen, die sämtliche Entwicklungszustände des Schmetterlings umfasst, nicht nur üher dessen Bau, sondern auch üher seine Physiologie und Biologie, seine Wandelungen und Aenderungen, Hahitus, Fundorte, Nahrungspflanzen, geographische Verteilung usw., die verwandtschaftlichen Beziehungen der Arten, die Varietäten usw. Aufschluss giht. Somit findet auch der Phaenologe üher die Schmetterlingswelt in ihrer Ahhängigkeit von klimatischen Einflüssen üher die Wohnbereiche der Arten usw. in Tutts grossem Werke eine Fülle der Belehrung, Anregung und Auskünfte. Dem Phaenologen, wie dem eigentlichen Sammler erleichtert das Buch die Arbeit ausserordentlich; Jahre lang müssten sie studieren, forschen, sammeln—und dann hätten sie doch noch lange nicht die Menge der für ihre Spezialarbeit in Betracht kommenden Angahen, Daten und zuverlässigen Informationen heisammen, die ihnen hier in Tutts Buche wie auf dem Präsentierteller dargehoten. zur sofortigen Verarheitung fertig, entgegengebracht werden. Es handelt sich aher nicht hlos um Zusammentragung einer Menge von Material aus allen nur erreichharen (britischen und ausserhritischen) Quellen, um die mit ausserordentlicher Sachkenntnis und gereiftem, fachmännischem Urteil durchgeführte Anordnung, Sichtung, Formung, Kondensation und Würdigung des ungeheueren Stoffes; sondern jeder Band des Werkes steuert auch zu dem wohlgeordneten und gesichteten Riesenvorrate des hisher hekannten Wissens, der früheren Beohachtungen noch reicbe Spenden ganz neuen, noch nirgends gedruckten Materials teils aus des Verfassers eigenem Wissensschatze, teils aus der Feder seiner Freunde und Mitarheiter hei. Bei einem litterarischen Unternehmen so umfassenden Charakters ist es ja unmöglich, dass die kolossale und vielseitige Arbeit von der Kraft eines einzelnen Menschen hewältigt werde. So enorme Arheit Tutt auch geleistet bat, so hedurfte er selhstverständlich doch der Mitarbeiter, und er fand sie unter den nambaftesten Fachmännern seines Vaterlandes. T. A. Chapman, A. W. Bacot, L. B. Prout, Kirhy, Durrant, Lord Walsingham, W. H. B. Fletcber, Dr. Wood und andere mehr hahen ihre Dienste dem Tuttschen Unternebmen geliehen; ausser diesen Gelehrten aher hahen noch üher 200 Entomologen auf die eine oder andere Art bei einzelnen Fragen ihre Beohachtungen, Aufzeichnungen, Listen, Berichte, Auskünfte zur Verfügung gestellt. Dazu ist die gesamte vorhandene Literatur, soweit sie in Betracbt kam und zugänglicb war, alles, was in Büchern, Abhandlungen, Fachblättern,

Magazinen, Vereinsberichten, Verhandlungen gelehrter Gesellschaften und Korporationen, Zeitungen usw. an einschlägigen Notizen und Erörterungen zu finden war, mit grosser Sorgfalt gesammelt worden. So sind nicht nur die britischen Quellen, sondern auch die ausländische Literatur (hauptsächlich die deutsche und amerikanische) herangezogen worden. Auch manche noch ungedruckte Arbeit konnte benutzt werden. Auf diese Weise ist denn ein Sammel-und Nachschlagewerk zu Stande gekommen, das besonders in seinem klassifikatorischen Teil eine wahre Fundgrube der Belehrung bildet. Was Vollstandigkeit betrifft (schreibt Merrifield), so steht Tutt's Werk in der Fülle der Detailangaben über alle den Biologen, Systematiker, Sammler, kurz jeden Fachmann interessierenden Fragen geradezu einzig da. Dazu kommt, dass das Buch bis auf die Gegenwart fortgeführt ist und die gesamte Literatur der zu dem Fach gehörigen Gebiete benutz hat. Die Klarheit der Darstellung erhöht noch den Wert und die wissenschaftliche Brauchbarkeit des Buches, das dem Forscher unschätzbare Dienste leistet als Ratgeber, der ihn kaum jemals im Stiche lässt und als Auskunftsbuch, das ihm nicht leicht die Antwort auf eine Frage schuldig bleibt, das vielmehr überall mit grossem Scharfsinn zusammengefasst die neuesten Ergebnisse der entomologischen Forschung darbietet und zwar ohne Weitschweifigkeit. in möglichst knapper, aber doch lesbarer Form. Dem Sammler geben die sorgfältig ausgearbeiteten Listen wohl beglaubigte Auskunft, wo und wann er jede Art der in dem Buche behandelten Schmetterlinge finden kann. Auch über die Jahreszeit, in welcher eine Schmetterlingsart erscheint ist ebenso, wie über ihre Wohnstätten, Fundorte und Nahrungspflanzen das gesamte Material in Tutts Werk zu finden. Ferner enthält das Werk vollständige Listen der Synonymen der einzelnen Arten und Gattungen, sowie der literarischen Hinweise, und diese Angaben sind zuverlässig. Tutt zeigt sich auch hier als ein Meister der Kompilation und knappen Zusammenfassung. Von besonderem Interesse und grossem Nutzen ist der Wiederabdruck der ersten Beschreibungen der einzelnen Arten. Doch sind auch neue Beschreibungen hinzugekommen, und alle Mitteilungen über Lebensverhältnisse und Entwicklung sind nach modernen Gesichtspunkten ausgearbeitet. Ein weiteres Verdienst des Buches besteht in der Vollständigkeit, mit welcher die fremden Ansichten angeführt und gewürdigt werden unter Hinweis auf die Gesichtspunkte, von denen der Verfasser dabei ausgeht. Hier tritt oft seine Selbständigkeit und Originalität recht deutlich hervor; überall bringt er in summarischer Form auch die neuesten und gewichtigsten Ansichten, vervollständigt aber diese Zusammenstellung noch durch die Ergebnisse seiner eigenen Forschungen und kritischen Untersuchungen. Tutt gründet seine Klassifikation hauptsächlich auf die Lebensbeschreibungen der Schmetterlinge, und da er hierbei das Ganze der Entwicklung, sämtliche Stufen und Eigentümlichkeiten, die Gesamtheit der Erscheinungen, alle Seiten der Sache im Auge hat, so ist sein Werk nicht nur ein Denkmal kolossalen Fleisses, unermüdlicher Arbeit und Sorgfalt, sondern es bedeutet auch einen wissenschaftlichen Fortschritt und hebt das Studuim seines Wissensgebietes auf eine weit höhere Grundlage, als die bisherige war. In der Beschreibung der einzelnen Spezies geht das Werk u. a. auf folgende Gesichtspunkte ein: 1. verschiedene Benennungen, 2. Originalbeschreibung der Art, 3. Imago, 4. sexeuller Dimorphismus, 5. Gynandromorphismus (Beschreibung aller bekannten Formen davon), Variationsformen, Abweichungen usw., 6 Vergleich mit verwandten Arten, 7. Eiblage und Ei, 8. Larve, 9. deren Habitus, 10. und Variation (Tabellen von sämtlichen Variationsformen der betreffenden Art), Vergleichung der Larve mit den Larven verwandter Arten, 11. Kokon (Doppelkokons und zusammengesetzte Kokons), Verpuppungsart, 12. Farbenänderungen am Kokon, 13. Auskriechen aus der Puppenhülle und Habitus der Imago, 14. Nährpflanzen (vollständige Verzeichnisse und Aufenthaltsorte), 15. verlängerte Dauer des Puppenzustandes, 16. Erscheinungszeit (phänologische Details). Puparium, 17. Fundorte (Listen für die Bezirke Britanniens), 18. geographische Verteilung (Listen der Verteilungsbezirke der Arten nach den einzelnen Ländern, in denen sie vorkommen). So gibt das Werk eine Uebersicht über die betreffenden Gruppen, Familien und Genera, über ihre Kennzeichen, Lebensweise, Klassifikation und ihre Verteilung in der ganzen Welt, über die Namen der Arten, über die Stellen, wo sich Beschreibungen der Arten, Varietäten oder andere Mitteilungen über sie finden, über die ganze, auf die Art, Gattung usw. bezügliche Literatur. Der Preis des Bandes beträgt 20 *M.* In Anbetracht der aufgewendeten Arbeit und angesichts der Tatsache, dass dieses Werk dem Forscher eine Masse Zeit, Mühe und Umstände erspart, und dass diese Bände gleichsam eine ganze Bibliothek darstellen voll Belehrung und Informationen, die man sich sonst in der Praxis nur mit grossen Schwierigkeiten oder überhaupt nicht zu beschaffen vermag, erscheint der Preis nicht übermässig hoch. Die britischen und amerikanischen Fachzeitschriften sind über das Tuttsche Werk des Lobes voll. Die Ermächtigung zur Verdeutschung des Werkes hat der Verfasser einem unserer Landsleute freundlicher Weise bereits übertragen. Vielleicht finden sich Subskribenten auf eine deutsche Ausgabe des Werkes in hinreichender Anzahl, um einem unserer Verleger die Besorgnis zu nehmen, er könne sich mit der Herausgabe einer deutschen Uebersetzung ein zu grosses geschäftliches Risiko aufladen. Fachgenossen, welche sich für die Angelegenheit interessieren, werden gebeten, sich mit Herrn O. Marpurg, Cöthen (Anhalt), Schützenstrasse 10, in Verbindung, zu setzen."—M. GILLMER, *Insekten-Börse*, March, 1903.

"British entomologists are to be congratulated on having obtained such a valuable handbook on their native lepidoptera, and we hope that the author will be able to complete the work on the same lines . . . . But to lepidopterists in other countries the work is of great importance, particularly for the comparative study of the variation in structure and habits of the same species in different regions. It is only to be regretted that the price of the work may render impossible its being obtained by some private students."—CHR. AURIVILLIUS, Hon. F.E.S., *Entomologisk Tidskrift*, April, 1903.

BRITISH LEPIDOPTERA.

Superfamily IX: SPHINGIDES (concluded).
Family: SPHINGIDÆ.
Subfam.: SESIINÆ.

This subfamily has already been dealt with somewhat at length in our consideration of the Sphingids *(antea*, vol. iii). It has also been characterised *(loc. cit.*, pp. 366—367) and compared somewhat in detail *(loc. cit.*, pp. 503 *et seq.)* with the Hemarids, a subfamily closely united by lepidopterists to the Sesiids, and it must be confessed that there is considerable resemblance between the two groups in all their stages except the pupal. The Sesiid egg is small, laid upon the foodplant, and possibly specialised to resemble the buds amongst which it is often placed. The larva is very typically Sphingid, with well-developed caudal horn, a small head, and only very slightly retractile thorax; in its first stadium it has tubercles i, ii, iii, iv generalised in position, that which is usually considered v being, as in other Sphingids, distinctly prespiracular, a feature apparently fairly characteristic* of the superfamily; each of these tubercles bears a single bifid hair; on the meso- and metathorax, however, i and ii are placed on a common base; in the later stadia, there is a growth of secondary bifid hairs. In these respects, Hemarid and Sesiid larvæ show striking resemblances. The pupæ, however, are characteristically different, and ally the species closely with the Eumorphids. Chapman, who has examined the pupa of *Sesia stellatarum*, and seen those of some half-dozen other Sesiid species that agree with it in general characters, says: "It is not easy to say wherein the Sesiid pupa differs from that of the Eumorphid section, in which the pupæ have the labrum dorsal and the front of the pupa occupied by a deep maxillary keel, whilst one is inclined to place the pupa of *Nephele* with the Sesiids rather than with the Eumorphids. The chief difference is that the Sesiid pupa is usually very markedly compressed from back to front, whilst the Eumorphid pupa is more or less cylindrical, *i.e.*, of circular section. Another frequent character (wanting in the pupa of *S. stellatarum)* is a raised line or ridge across the anterior margin of the segment dorsally, passing close in front of the spiracle as it fades out

* Bacot has recently found v united with iv on a common base on the 1st abdominal segment of the larva of *Hyles euphorbiae* in its first stadium.

anteriorly. The Sesiid pupa agrees with the Eumorphid, in that some species have the anal spike sharp and pointed, whilst others have it rounded or spoon-shaped at the end. The pupal structure leaves little doubt that the Sesiids are a branch of the Eumorphids and are not directly related to the Hemarids. The pupæ of many of the species have a tolerably firm structure, but that of *S. stellatarum* is more typical in shrivelling up if it dies, whilst, on dehiscence, it more usually twists and shrivels up than retains its natural outline. It has a very delicate skin, connected no doubt with the fact that it pupates above rather than under the ground, and, perhaps, more especially, that it does not hybernate as a pupa but passes a very short time in that stage." Kaye remarks *(in litt.)* on the immensely varied characters shown by the Sesiid imaginal structures, *e.g.*, the antennæ (which range from fairly long and slender to somewhat short and thick, whilst sometimes they are moderately clubbed and in others scarcely so), and the tufted abdomen (which appears to be only of service as a character when considered in conjunction with other structures, and sometimes varies sexually). The hind tibiæ he finds to be more bristly-scaled in the Sesiids than in the Eumorphids, and states that, frequently, quite a tuft of scales occurs round the base of the spurs. These latter, too, appear never to be so free and conspicuous in the Sesiids as in the Eumorphids. He suggests that the greater number of the *Sesiinae* fall into three natural tribes:

1. Wings not angulated; ♂ and ♀ with anal and lateral tufts .. .. SESIIDI.
2. Wings angulated.
   a. ♂ and ♀ tufted .. .. THYREIDI.
   b. ♂ only tufted .. .. LOPHURIDI.

These tribes would not embrace all the genera hitherto included in the *Sessiinae*. Undoubtedly further tribes will have to be erected for some of the more isolated genera.

Tribe: SESIIDI.

This tribe is well-characterised by the widely distributed and well-known *Sesia stellatarum*. Its structure has been already dealt with in our consideration of the subfamily. The imagines are remarkable for their swift flight, seeking flowers by day, into which they thrust their long maxillæ whilst poised on the wing. [Reference to Bates' comparison with the true humming-birds *(Nat. on River Amazons*, pp. 182—183) may be made here.] The imagines are well-scaled and usually have a markedly tufted abdomen. Kaye notes, however, that *Enyo* is decidedly nocturnal in its habits, but, in spite of being somewhat aberrant, is still distinctly Sesiid. The tribe is widely distributed throughout the whole of the Old and New Worlds, but is particularly abundant in the Indian region, tropical Africa and tropical America.

Genus: SESIA, Fabricius.

SYNONYMY.—Genus: *Sesia*, Fab., "Sys. Ent.," p. 548 (1775); "Spec. Ins.," ii., p. 154 (1781); "Mant.," ii., p. 99 (1787); "Ent. Syst.," iii., 1, p. 380 (1793); "Ill. Mag.," vi., p. 287 (1807); Leske, "Anfangs. Nat.," p. 458 (1779); Cuv., "Tabl. Elem.," p. 593 (1797); Leach, "Edinb. Encycl.," ix., p. 131 (1815); Kirby, "Ent. Mo. Mag.," i., p. 210 (1865). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 493 (1758); xiith ed., p. 803 (1767); "Faun. Suec.," ii., p 288 (1761); Poda, "Ins. Mus. Graec.," p. 82 (1761); Scop., "Ent. Carn.," p. 187 (1763); Hfn., "Berl. Mag.," ii., p. 182 (1766); [Schiff.,] "Schmett. Wien.," p. 43

(1775);] Ill.'s n. Ausg., p. 20 (1801); Esp., "Schmett. Eur.," ii., p. 114, pl. xiii., figs. 1—3 (1779); Bergst., "Sphing. Larv.," p. 11 (1782); Retz., "Gen. et Spec. Ins.," p. 33 (1783); Geoff., "Fourc. Ent. Paris.," ii., p. 253 (1785); Bork., "Sys. Besch.," ii., pp. 56, 134, 177 (1789); Don., "Brit. Ins.," v., p. 41, pl. 155 (1796); Hb., "Eur. Schmett.," fig. 57 (1796); text p. 94 *(circ.* 1805); "Larvæ Lep.," ii., Sph. iii., Legit. A. q. c., fig. 1 a, b *(circ.* 1800); Haw., "Lep. Brit.," p. 65 (1803); Latr., "Hist. Nat.," iii., p. 401 (1802); xiv., p. 133 (1805); Ochs., "Die Schmett.," ii., p. 193 (1808); Shaw and Nodder, "Viv. Nat.," xxi., pl. 872 (1810); Godt., "Hist. Nat.," iii., p. 55 (1821). *Macroglossum*, Scop., "Int., Hist. Nat.," p. 413 (1777); Lam., "Hist. Nat. An. sans Vert.," iv., p. 9 (1817); Swains., "Zool. Illus.," i., expl. pl. 64 (1821); Kirby & Spence, "Int. Ent.," iii., p. 557 (1826). *Bombylia*, Hb., "Tent.," p. 1 (1806); "Franck Cat.," p. 87 (1825). *Sphinx (-Macroglossum)*, Latr., "Gen. Crust. et Ins.," iv., p. 210 (1809). *Setia*, Oken, "Lehrb. Zool.," i., p. 749 (1815). *Hemaris*, Dalm., "Vet. Acad. Hand.," p. 207 (1816). *Macroglossa*, Ochs., "Die Schmett.," iv., pp. 41—42 (1816); Stphs., "Ill. Haust.," ii., p. 133 (1828); "Cat. Br. Ins.," ii., p. 34 (1829); "List Br. An. Br. Mus.," p. 29 (1850); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); "Gen. et Ind. Meth," p. 45 (1840); "Hist. Nat. Sphing.," p. 337 (1875); Meig., "Eur. Schmett.," ii., p. 127 (1830); Dup., "Hist. Nat.," supp. ii., p. 164 (1835); "Cat. Méth.," p. 43 (1844); Dunc., "Brit. Moths," p. 164 (1836); Wood, "Ind. Ent.," fig. 20 (1839); Curt., "Brit. Ent.," xvi., pl. 747 (1840); Humph. and West., "Brit. Moths," i., p. 24 (1841); Evers., "Faun. Volg. Ural.," p. 107 (1844); H.-Sch., "Sys. Bearb.," ii., p. 84 (1846); Dbld., "List Brit. Lep.," p. 3 (1847); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Speyer, "Geog. Verb.," i., p. 314 (1858); ii., p. 280 (1862); Sta., "Man.," i., p. 98 (1857); Humph., "Gen. Brit. Moths," p. 11, pl. iii., figs. 5—6 (1860); Staud., "Cat.," ed. 1, p. 17 (1861); ed. 2, p. 38 (1871); ed. 3, p. 104 (1901); Ramb., "Cat. Lép. Andal.," p. 122 (1866); Snell., "De Vlind.," p. 92 (1867); Berce, "Faun. Franç.," ii., p. 31 (1868); Nolck., "Lep. Fn. Est.," i., p. 90 (1868); Newm., "Brit. Moths," p. 11 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 121 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 401 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 42 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 114 (1875); Butl., "Trans. Zool. Soc.," ix., pt. 10, p. 524 (1876); Kirby, "Eur. Butts. and Moths," p. 741, pl. xx., figs. 1 *a—c* (1879); "Cat.," p. 629 (1892); "Handbook," &c., iv., pp. 8—9 (1897); Frey, "Lep. Schweiz," p. 59 (1880); Poult., "Trans. Ent. Soc. Lond.," 1884, p. 298 (1884); Buckl., "Larvæ," &c., ii., p. 113, pl. xxvi., fig. 2 (1887); Auriv., "Nord. Fjär.," p. 47 (1889); Minà-Pal. and Failla-Ted., "Nat. Sic.," vii., p 135 (1888); Meyr., "Handbook," &c., p. 294 (1895); Barr., "Lep. Brit.," ii., p. 66 (1895); Tutt, "Brit. Moths," p. 33 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 216 (1899); Cann., "Riv. Ital.," xxi., pp. 10—17 (1901). *Hemaris*, Dalm., "Vet. Ak. Handl.," xxxvii., p. 215 (1816). *Psithyros*, Hb., "Verz.," p. 132 *(circ.* 1822); Stephs., "Ill. Haust.," app. p. 5 (1834). *Rhamphoschisma*, Wallgrn., "Skand. Het.," i., pp. 49—51 (1863).

The heterotypical genus *Sesia* was erected by Fabricius in 1775 for section III of Linné's comprehensive group *Sphinx*. It was diagnosed *(Sys. Ent.*, p. 548) by Fabricius as follows:

Palpi reflexi, lingua exserta, truncata. Antennæ cylindricæ, extrorsum crassiores—*Tantalus, hylas, stellatarum, thysbe, fuciformis, apiformis, haemorrhoidalis, culiciformis, tipuliformis.*

The extended description of the genus by Fabricius, and the fixing of its type by Cuvier in 1797 as *stellatarum*, have already been detailed at length *(anteà*, vol. iii., pp. 344—345). Fabricius, himself, also chose the Sphingid section of *Sesia* to represent the genus in 1807 (see *anteà*, p. 347). Meyrick describes *(Handbook*, p. 294) the genus under the name of *Macroglossa* as follows:

Tongue strongly developed. Antennæ over ½, gradually thickened to near apex, then pointed, apex slender, hooked. Abdomen broad, smooth, with broad truncate expansible anal tuft, last three segments with expansible lateral tufts. Tibiæ hairy. Wings wholly scaled.

The genus *Sesia* is found throughout the greater part of the

Old World, and is particularly numerous in the Indian Region. The moths may be generally recognised by their strongly thickened antennæ, hooked at the tip, the thickly scaled dark brown or blackish forewings, more or less coppery-red hindwings, and the undentated hind margins. The black anal tuft, too, is very conspicuous. Nearly all the species are very similar to *Sesia stellatarum* in size, colour, shape and general appearance. Their mode of flight is too well known to need any detailed mentioning.

Bartel gives (*Palaeark. Gross-Schmett.*, ii., p. 213) the following table for the determination of the Palæarctic species belonging to this genus:

Wings scaled throughout. Forewings dark with blackish markings.

1. Hindwings sulphur-yellow, etc. .. .. .. *caudata*, Brem. and Grey.
2. Hindwings ochre-yellow; at the base blackish-grey, before the outer margin narrowly red-brown. Antennæ blackish-grey. Thorax unicolorous. Abdomen on the sides of the first two segments without yellow spots .. .. *stellatarum*, L.
3. Hindwings black-brown, with an orange-yellow transverse band in the middle, etc. .. *saga*, Butl.

Sesia stellatarum, Linné.

Synonymy.—Species: *Stellatarum*, Linn., "Sys. Nat.," xth ed., p. 493 (1758); xiith ed., p. 803 (1767); "Faun. Suec.," ii., p. 288 (1761), etc. *Flavida*, Retz., "Gen. et Spec. Ins.," p. 33 (1783). *Stellarum*, Geoff., "Fourc. Ent. Par.," p. 253 (1785); Latr., "Hist. Nat. Crust. Ins.," xiv., p. 133 (1805). *Nigra*, Cosmovici, "Le Nat.," xiv., p. 280 (1892); Kirby, Nov. Zool.," i., p. 99 (1894). [N.B. All other references mentioned under the generic synonymy (*anteà*, pp. 2-3) are referable to *stellatarum*.]

Original description.—*Sphinx stellatarum*, abdomine barbato lateribus albo nigroque variis, alis posticis ferrugineis. Merian, *Eur.*, 2, p. 33, t. 29, Réaum., *Ins.*, i., t. 12, f. 5, 6. Roes., *Ins.*, i., phal. i, t. 8. Bradl., *Natur.*, t. 26, f. 1, A. Habitat in *Galio*, *Rubia* (Linné, *Sys. Nat.*, xth ed., p. 493, no. 26).

Imago.—54mm.—60mm. Head, thorax and abdomen blackish-grey, the middle abdominal segments paler and with a pale yellowish lateral patch on either side of these segments; a black angular transverse mark behind the paler area; black and white lateral tufts to terminal segments of abdomen and black anal tuft. Anterior wings blackish-grey, sometimes with a slight ochreous tinge; an indistinct basal line, a black transverse line at some distance from base, black angulated line from costa to anal angle; a dark terminal shade, broader at apex and very narrow at anal angle; fringes of same colour as outer marginal area. Posterior wings coppery- or ochre-yellow, slightly darker at outer margin, covered with long grey scales at base; a dark outer marginal line from apex to two-thirds towards anal angle; fringes paler, greyish-ochreous.

Sexual dimorphism.—In this species sexual dimorphism is reduced to a very trifling amount. The antennæ in both sexes have about 52—56 joints, each carrying dorsal scales arranged in two obvious and tolerably regular rows, and with a third row close to the base and hidden (being formed of short scales) by the terminal row of the preceding segment. The male has well-developed hairs in the ordinary pocket or slipper-toe arrangement of the Sphingids, the female a smooth under-surface with fine hairs. The anterior tibial spine is slightly variable, but arises in the female a little further from the base of the tibia than in the male, and is, therefore, very slightly

shorter. The frenulum has been already referred to (*antea*, vol. iii., p. 502). It is difficult to say that there is any sexual difference in wing colour or pattern, or in the lateral abdominal tufts. The ♂ possesses, but extremely small, by the side of the 2nd abdominal segment, the fans so well developed in some Sphingids (Chapman).

Gynandromorphism. — Only two gynandromorphous specimens appear to have been described. The sexual differences being so slight, great care should be taken in recording such. Those described are:

α. Halved. Right side ♀, left side ♂. Right pair of wings ♀, left ♂ (smaller). Right antenna larger than the left. Right side of the body more ♀, more voluminous, left side ♂. On the abdomen traces of both sets of sexual organs present. Bred in 1896. In Hartmann coll. (Schultz, *Ill. Woch. für Ent.*, ii., p 395).

β. Preponderantly ♂. Right antenna ♂, left ♀, All else purely ♂. Bred a long time since from a larva found near Ratibor by Hyckel. In Hyckel coll. (Schultz, *Ill. Zeits. für Ent.*, iii., p. 137).

Variation.—This species, in spite of its remarkably wide distribution, is not subject to a very great deal of variation. Bower records a specimen captured at Sandgate that measures only 30mm. from tip to tip of its forewings. Piochard de la Brulerie describes (*Ann. Soc. Ent. Fr.*, 1863, p. 666) an albinistic aberration, the ground-colour of both pairs of wings being greyish-white, the hind tinged with yellow, and with the dark border almost typical. Mosley notes one with the hindwings very dark, and suffused with orange-brown. Oberthür observes that the Askold examples have darker brown hindwings than those from Europe, and that the same form occurs in Japan. Strangely, Fletcher mentions that the specimens from North China and Japan are very typical. The Teneriffe examples are also said to have the hindwings somewhat deeper brown. Bartel says (*Palaeark. Gross-Schmett.*, ii., p. 217) that "aberrations have been observed in which there is a broad, velvety-black transverse band on the fore-wings. Other specimens vary considerably in the tint of the hind-wings. Thus Ochsenheimer refers (*Die Schmett.*, iv., p. 175) to one in which the hindwings show no yellow at all, but are unicolorous black-brown; also the one described by Herr Karl Uffeln, of Nietberg (*Iris*, viii., p. 170), agrees with the above specimen of Treitschke's [*sic*] in certain respects. It came from a normal autumnal larva and pupa, and the brown colour of the hind-wings extends to the whitish-mixed abdomen." These alone are sufficient to show that there is some variation in European examples in the tint of the hindwings, and this is borne out by the specimens in the British Museum coll., where it is quite clear that local or aberrational variation exceeds manifold the geographical variation. This is exactly what might be expected with a species, individuals of which travel many miles, possibly hundreds of miles, and so must cross practically throughout their whole range within a few years. One of the most remarkable matters connected with this well-known species was its re-description by Cosmovici in *Le*

* Caradja notes in his preface (*Iris*, viii., p. 2) that he wrote to Cosmovici repeatedly, asking if he could see his types or for further information, but never received a word in reply, and this, coupled with the fact that, although Cosmovici had not been able to name his Geometrids except *sambucaria*, he had been fortunate enough to discover two or three new Erebias, a new Theclid, and this new *Macroglossa*, in Roumania, leads one to suppose that the publication of this note is due to sheer ignorance, and is not to be taken seriously.

Naturaliste, xiv., p. 280.* That it was not a specially dark aberration that he named, appears clear from his note, "fort commun aux mois de Mai et de Juin." His description reads:

Macroglossa nigra (n. sp.).—Lépidoptère fort commun aux mois de mai et de juin, à vol fort rapide en plein jour et à l'ardeur du soleil. Ailes supérieures d'un noir corbeau, sans taches. Les inférieures d'un fauve roux, presque transparentes, avec la base un peu obscure et une bordure terminale fine, noire. Tête et thorax gris, fort poilus; abdomen de la couleur des supérieures. Les poils latéraux de la base de leur queue d'oiseau ont la même coloration grise que le thorax.

EGGLAYING.—Of the egglaying of *Sesia (Macroglossum) stellatarum*, Prideaux writes (*Ent. Rec.*, xii., p. 268) that, from July 10th-20th 1900, this species was abundant on the South Devon coast where he repeatedly had the opportunity of watching it egglaying on *Galium mollugo* while hovering on the wing. The insect, he says, selects the top of a flowering spray as a rule, carefully examining it before depositing an egg. Rejected sprays, on being subsequently searched, were found to have been previously bespoken for the purpose; two eggs of this species were never laid on the same panicle of the plant although ova of *Anticlea rubidata*, and probably those of species of the genus *Melanippe*, were commonly found near those of *S. stellatarum*. The green globular egg of the latter, though large, is not a very conspicuous object amongst the masses of round buds of the *Galium*, on which it is usually deposited; but it has been occasionally found laid on one of the upper whorls of leaves. The egg period, Prideaux notes, lasted only seven days. Harwood observes that the eggs are laid by the ♀ on the flowers and flower-buds of *Galium mollugo*, that she does not alight during the process but keeps on the wing all the time, curling up her abdomen so as to place the egg on the underside of the flower or bud (Buckler's *Larvae*, ii., p. 120). The eggs are laid singly, only one in the same place, on leaves and upper twigs of *Stellatae*. A specimen was watched at Arcachon laying its eggs on leaves of *Rubia tinctorum* precisely as noted by Harwood (Chapman). Laid at the junction of the pedicels of the flowerets of one of the lower lateral branches of the main spike of flowers of *Galium verum*; each egg is laid on its long side, and its semitransparent green colour makes it very inconspicuous among the flowers and buds of the yellow bedstraw, and matching wonderfully well in size and appearance the young seed-capsules thereof, although it differs considerably in colour, being of a brighter and more pearly green (Bacot). Eggs laid from November 1st—5th, 1901, in confinement, at Scarborough (Head). Ransom observes that, waiting patiently by a patch of *Galium verum* in the hot sun, he watched a ♀ hovering over the flowers, neither alighting nor sucking the honey; after a short time it selected a head, clasped the flowers with all its legs, turning at the same time its abdomen down and placing an egg on the side of one of the small unopened buds of the *Galium*; the moth vibrated its wings very rapidly throughout the process, possibly for the purpose of supporting itself, as otherwise its weight might bear down the flower-head. The act of oviposition was observed on many occasions and he was thus enabled to verify his first impressions. The ovum was nearly always placed on an unopened flower-bud, occasionally, however, on the underside of a leaf (out of some 200 found, he obtained only a very small number laid on leaves). He further states that, when the flower opens, the

egg, if laid on a bud, is, of course, turned downwards, and the petals, though small, hide the egg; when the plant is in full bloom one might suppose that the egg had been deposited in the centre of the flower-head which, however, is not the case; if a plant be in bloom at the time of oviposition the egg is placed on the open flower; the proboscis may be thrust into a flower during oviposition, but it is certainly the exception and not the rule. The moth appears to lay but one egg on a flower-head, but, on one occasion, he found five placed singly on a single flower-head, on another a cluster of three, and several times two, but his observation leads him to doubt their being laid by the same individual. He further notes that it is recorded that the abdomen is turned upwards when egglaying, but that he never saw any attempt whatever at an upward movement although he watched most carefully. Of five ova deposited on July 11th, 1901, one hatched on July 15th and four on July 16th, this giving, in this case, an oval period of only 4—5 days. Grote also notes mode of egglaying (*Zool.*, p. 7153).

Ovum.—Green in colour; almost a sphere in form; but it has a longer (micropylar) axis and a circular outline at right angles to this; the length is almost exactly 1mm. and the transverse diameter 0·9mm., some eggs are a little smaller than this, but the diameters have the same ratio; the micropyle was not made out; the surface sculpturing is in the form of a very shallow set of pits, the lines of the netting being little raised above the general surface; the reticulation is of 5- and 6-sided pits of a diameter of 0·02mm. (Chapman. Described November 14th, 1901, from eggs obtained by Head, of Scarborough). (1) Of a somewhat darker green than the egg of *Theretra porcellus*, and more strongly sculptured; about 0·9mm. in length by 0·8mm. in width, with a well-marked rosette of cells around micropyle; apparently quite filled by contents and without depression (July, 1901. Laid on flowering shoot of *Galium aparine*). (2) A short rounded oval, flattened and depressed at sides, small, and of a bright semitransparent green colour; about 1mm. in length, 0·9mm. in width, and about 0·9-0·8mm. in thickness; the surface smooth and pearly, but not highly varnished; with a shallow and poorly marked surface cell-pitting (July 29th, 1900. Laid on flower pedicels of *Galium verum*) [Bacot]. Almost exactly 1mm. in length, and only just under 1mm. in width, the outline being almost a circle, the height rather less than the width, still the egg has the general appearance of being nearly spherical, some with a fairly large, irregularly oval, hollow depression on the upper surface (opposite point of attachment) others without; the surface distinctly covered with an irregular polygonal reticulation, the network becoming more distinct at the micropylar end, which is somewhat flattened; the micropyle appears to be composed of a number of radiating cells which outwardly distinctly run into the surrounding cells that form the ordinary network; colour at first bright pea-green, changing to yellowish with green areas as the embryo matures; the shell is quite transparent, and the embryo is very distinctly to be seen through it, and the structure of the young larva, and its striking bifid hairs may be clearly distinguished [Tutt. Described July 10th, 1901, from eggs found attached firmly to leaves of *Galium verum* by Mr. Ransom, a few days previously].

Habits of larva.—Sepp worked out (*Ned. Insecten*, ii., no. 52) the life-history of this species over 100 years ago. He observed that the larvæ hatched on July 7th, 6 days after the eggs were laid, moulted for the 1st time 3 days after this (July 10th), moulted a 2nd time 4 days later (July 14th), moulted a 3rd time 4 days later (July 18th), and a few days later for the 4th and last time, changing colour when wandering off for pupation. Clifford notes (*Ent.*, ii., p. 298) the extreme rapidity of growth after the 2nd moult, there being only 4 days between the 2nd and 3rd, and 4 between the 3rd and 4th moults; he further states that after the larva has formed its cocoon it continues in the larval state nearly a fortnight before the pupal state is assumed. Prideaux says that the young larvæ can suspend themselves by a thread when disturbed. Some that left the eggs on July 16th, 1901, were observed to moult on July 19th and on July 29th, turning a very dark green colour after the last moult (almost black), and, being fullfed, commenced to spin on August 3rd and pupated on August 8th (Ransom). Bacot observes that the larvæ were exceedingly abundant at Frinton on August 6th, 1900, feeding on the bedstraw growing on the landward side of the seawall; they were mostly in the final instar, and many quite fullgrown. Referring to their protective habits, he states that they were far less conspicuous than one would have considered possible; the weight of the larva bends the bedstraw downwards, and the larva feeds with its ventral area uppermost, and, in this position, the colour corresponds well with the sage-green tinted leaves of the small reeds and coarse grasses among which the bedstraw grows. He says that the larvæ were so crowded that one could count two or three dozen without moving, probably because the foodplant only grows on a small part of the seawall, about 100 yards in length, and no trace of *Galium verum* could be found elsewhere in the neighbourhood. Hayward observes that the larvæ were so common in 1865, at Devonport, that above 100 were taken in various stages of growth during the first three weeks of August, every clump of *Galium* sometimes containing several. In 1888, the larvæ were exceedingly abundant on the southeast coast of Kent throughout the whole of September. At Walmer and Kingsdown, on the small isolated patches of *Galium* growing on the shingle, the larvæ of this species (and those of *Celerio gallii*) were in unusual abundance, those of *S. stellatarum* hiding low down during the day. The larvæ pupated in due course, and either emerged (or died failing to do so) during late October and November. In July, 1894, high up on the French side of the pass leading over the Little St. Bernard, a magnificent plant of *Galium verum*, growing on a rocky wall by the roadside, tempted one to examine it, with the result that a very large fullfed larva of *S. stellatarum* was discovered clinging to the underside of one of the main flowering branches, but not before its presence was made known by its coming in contact with the hand; it was then feeding, and the time about 7.30 p.m. (Tutt). Larvæ were found feeding by night at Painswick (Watkins); in nature, nocturnal feeders, and found with difficulty, as a rule between 6 p.m. and dusk. Wherever the foodplant shows signs of being much eaten, search should be made (Ransom); appear to prefer the plants of *Galium mollugo* growing on old walls exposed to the sun (Chaumette); appear to feed exposed on *G. verum* and *G. mollugo* growing on sunny banks

&c. (Holland); frequently found on isolated plants at Brighton (Merrifield); frequently in batches, several larvæ being found on a small patch of *Galium* at Lincoln (Musham); the larvæ prefer sunny localities, occur very commonly in certain years, even in places where it is otherwise seldom found (Bartel); appear to be found most frequently on plants of shorter growth and less intermixed with grass on the Lancashire and Cheshire sandhills; it may readily be traced by the exposed black frass, and rarely wanders far away till ready to pupate (Moss). The larvæ may be found almost all the year through, in such years as the insect visits us, early June, late July and early August and September being possibly the months preceding the three more or less uncertain broods that we have in favoured seasons here, but much depends upon the season, for, in some years, larvæ are only obtainable in July and August and late September and October, the latter usually being exterminated by the early frosts. Robson notes that a larva dropped in water, by accident, very quickly recovered. The following notes may be of interest:—Larvæ in Upper Austria, June and September-October (Himsl); 20 larvæ on *Galium verum*, July 26th-August 26th, 1857, at Ilfracombe, August 25th, 1859, at Braunton Burrows (Mathew); rather young larvæ on August 19th, many quite small and almost fullfed larvæ from August 20th-September 5th, 1857, at Brighton (Merrifield); a very large number of larvæ during the last week of September, 1859, these spun up in early October, and produced imagines at the end of the same month, the pupæ that did not do so then died; no pupa remained alive until the next year (Hellins); larvæ, August 5th, 1865, at Rottingdean (Image); larvæ abundant at Devonport during the first three weeks of August, 1865 (Hayward), and in September, 1865, at Scarborough (Lighton), and from October 6th, 1865, onwards at Barnstaple (Mathew); August 12th-24th, 1867, August 28th, 1872, fullfed, figured by Buckler (Hellins); July 10th, 1872, at Pangbourne, August 17th, 1890, at Hardwick, July 20th, 1898, at St. Helens, Isle of Wight (Holland); August 30th, 1873, at Dover (A. H. Jones); larvæ, fullfed, August 4th, 1875, at Lee, August 22nd, 1892, larvæ at Deal, August 12th, 1893, at Folkestone (Fenn); very abundant October 24th, 1878, at Gallipoli (Mathew); August 17th-30th, 1879, at Yarmouth (Lockyer); larvæ plentiful at Cleethorpes, August 23rd, 1879 (Auld); September 11th, 1886, not halfgrown (Porritt); throughout September, 1888, abundant at Deal, Walmer, and Kingsdown (Tutt); 31 larvæ in various stages between September 1st-5th, 1889, in South Devon, and larvæ common at Sidmouth in July, 1898 (Wells); larvæ, nearly fullfed, August 26th, 1890, and August 29th, 1894, at Reading (Butler); in July, 1892, a dozen larvæ, and several on July 22nd, 1898, at Westgate (Sich); larvæ, August 21st, 1892, at Braunton (Bartlett); July 15th-24th, 1893, at Wicken (Mitchell); August, 1897, larvæ abundant at Walmer (Griffiths); larvæ young and fullgrown at West Kirby on September 15th, 1897 (Moss), August 3rd, 1898, at Sidmouth, eggs and plenty of young larvæ on July 27th, 1901, at Hazeleigh (Raynor); larvæ, July 12th, 19th, 27th, 29th, and 30th, 1899, August 17th-21st, 1900, at Sudbury, also larvæ July 18th-20th, 1899, at Henny, and from July 20th-August 6th, 1901, in the Sudbury district, by the latter date they were all fullfed

(Ransom); larvæ, July 14th, 1899, on *Galium verum* at Benfleet (Whittle); larvæ, fullfed, in September, 1901, at Margate (Barrett).

LARVA.—*First instar* (nearly fullgrown): Very small, only about 3mm. in length, colour of a much brighter yellow-green than the tint of any other Sphingid larva known to me in this stage. In general shape, the larva is cylindrical, rather short and stout, not tapering to any appreciable extent. The head rounded, not very small (considering that the larva described is near moulting), bears a few black hairs, not bifid. The junction of head and thorax marked by a black line, as is also the junction of the lobes and the line of clypeal triangles. The body tubercles large, black, chitinous, almost wart-like in their large size, yet each only bearing a single hair except on the meso- and metathorax on which iii carries two hairs, and i and ii have a common base bearing the two setæ on the 3rd subdivision of the segment; on the abdominal segments i and ii are placed trapezoidally, i on the 3rd and ii on the 6th subdivision of each segment; on the meso- and metathoracic segments, iii is on the middle subsegment and carries two hairs, while of the subspiraculars only the prespiracular (v) is in evidence, iv, as is usual in the Sphingid larvæ, being absent. On the abdominal segments, iii is single-haired and placed on the 4th subsegment of each segment; iv is on the lateral flange below and slightly posterior to spiracle; the prespiracular (v) is on the anterior edge of the segment, almost directly in front of the spiracle. There appear to be 8 subsegments to each abdominal segment, judging by the rows of shagreen tubercles or mammillæ of the next skin now showing through, and 5 to the meso- and metathorax. The setæ are stout black bristles, much larger than those of *Eumorpha (elpenor)* and *Theretra (porcellus)*, and bifid at the tip. The prothoracic scutellum does not differ in colour from the general tint of the body, but is distinctly raised above the general skin surface; it bears 6 tubercles on its anterior and 4 on its posterior margin, the outermost of the anterior row carries two setæ; the only other tubercle on the prothorax above the ventral area is the prespiracular and this also bears two setæ. The horn is peculiar, being either black or very dark purple, short and thick, tapering but slightly, and rising abruptly from the skin-surface, in fact, it looks like an enormously raised tubercle, it contrasts so strongly with the skin; it is roughened by minute spicules or bristles and bears, as usual, the anterior trapezoidals (i) at the summit. The spiracles are rimmed with black chitin, very large on prothorax and the 7th and 8th abdominals, small on abdominal segments 1—6 (about half the size of those on 7 and 8). The three anal plates are of a tint varying from dark dusky to black. The prolegs bear small, flat, dusky-coloured plates, on which the marginal series of hairs are situated, and the ventral tubercles above the legs bear two hairs, those on the 1st and 2nd abdominals being single-haired. The lateral flange is fairly developed, both iv and the prespiracular (v) are placed on it, iv on the summit of the ridge and the prespiracular (v) on its upper edge, on that part which curves upwards somewhat at anterior edge of segment. *Second instar:* The usual change that Sphingid larvæ are subject to at 1st moult has occurred. The primary setæ and tubercles are greatly reduced in size (comparatively with size

of larva), the former differing but slightly in size from the numerous secondary shagreen hairs which now appear, and which form so marked a feature of the larva ; these hairs are small black bristles with a bifid tip, each placed on a raised bright yellow-coloured mammillary base, the pigment spreading over the skin surrounding the base of the tubercle and forming a distinct spot. The hairs on the head are much more numerous than in the last instar, and they also partake of the shagreen character except that the hairs themselves are apparently simple and have no bifid tip, whilst their bases are black as is also the skin area immediately surrounding them ; the bases of hairs are also black on the scutellum and anal plates. The larva is still cylindrical with a small head, the body tapering scarcely at all or only very slightly ; the horn is more slender, still of a deep purple-red colour, and carrying numerous bristly bifid hairs ; the prothorax is now divided into 6 subsegments as well as the scutellar area, the mesothorax has 7, the metathorax and abdominal segments are each composed of 8, subsegments. The colour of the larva is bright but deep green, although the yellow shagreen spots modify it and give it a more glaucous tint, while the hairs give it a brownish hue to the naked eye. A narrow mediodorsal stripe is present, in part formed by the absence of shagreen spots in its area, and a subdorsal yellowish stripe is formed by the shagreen spots following in regular sequence, and the yellow colour of their bases spreading along this area ; this subdorsal line runs horizontally from head to 8th abdominal segment, and there turns up to the base of the caudal horn. The spiracles are conspicuous and they bear the same relative sizes as in the 1st instar except that on the 7th they are a trifle smaller than those on the 8th, but still larger than those on abdominal segments 1—6 (July 18th, 1901). *Penultimate instar :* The most noticeable feature of this instar is that the development of the shagreen hairs is much stronger ; those on the head being black and distinct, although short, and some of them are bifid at the tip ; those on the body are black, deeply forked at the tip. Some of the primitive setæ are still in evidence, being longer than the shagreen hairs, and not bifid at the tip. Tubercles i and ii still appear as trapezoidals, iii is well above and slightly posterior to spiracles, iv directly below on the subspiracular flange. The horn is not degenerating at this stage and has two hairs at tip although it is not distinctly forked ; in addition to the shagreen hairs, there is a coat of minute short black spicules present, except on the coloured areas of the longitudinal bands and the coloured skin-bases of the shagreen hairs (July 29th, 1900). *Final instar ;* Head small ; thoracic segments tapering ; the larva, as a whole, slender and of elegant shape. Head, dull sage-green in colour, rather tall, a rounded trapezoid in shape, notched at crown ; the mandibles and upper joints of antennæ pale brown ; the bases of antennæ and mouthparts (other than mandibles) green ; ocelli pale brown or yellowish ; numerous fine short hairs scattered over surface. Body pale apple-green above to dull glaucous or sage-green beneath ; a broad white subdorsal band edged above with dark green is present on abdominal segments ; this turns upwards, and ends at the base of the horn ; forward it narrows down, and is yellowish rather than white, becoming

fainter on thoracic segments, and ending just behind the scutellar plate; a broad, vivid, yellow subspiracular band is present, and the anal flap is edged with the same colour; on the thoracic and 1st abdominal segments this band is situated on a raised fold or flange of the skin; there is a tendency in many larvæ for the spiracular yellow band to be shaded above and beneath with a dusky reddish hue. The horn is sharp, slender, blue-green in colour, with black tubercular hair-bases for about four-fifths of its length; the remainder (apex) is orange-yellow, and the hairs on this portion without dark bases. Spiracles edged with a black chitinous rim, and, excepting the prothoracic, which are whitish, they are almost black, although a little white is noticeable within the dark rim in some larvæ. The shagreen hairs are now very fine and weak, surrounded by a coloured skin-area of greater or less extent; above the spiracular band these are white (often very brilliant), those below the band are yellow; none of the shagreen hairs are forked in this stage. A very faint mediodorsal line may be detected. The true legs are reddish-brown; the extremities of the prolegs are pink; above this pinkish area is a bright yellow stripe on the outer side of proleg, and above this again a black dash (August 3rd, 1900). *Another adult larva* is bright green, with a yellow subdorsal band and a whitish-yellow lateral band below the spiracles. The horn well-developed, blue o within one-third of tip, then a ring of black, the tip yellow; the anal flap outlined in yellow; tbe spiracles black, the skin round the bases of shagreen hairs white, giving the larva a speckled appearance. [On the whole the appearance of the larva is rather Amorphid than Eumorphid.] The subsegments clearly defined, 8 on the abdominal segments, the first three not conjoined to make one enlarged 1st subsegment, as in larva of *Theretra porcellus*. The shagreen hairs arranged on the top of the subsegments, as in Amorphid larvæ; they are short and rather curved at tip; on the horn they are larger and straight; the tubercular bases of the hairs on the horn form tall black cones, giving the horn a very rough and thorny appearance. The thoracic segments taper much towards the head, which is small, and somewhat squared in outline (Bacot). The *fullgrown larva* is about 45mm. long, stout, but tapering from segment 5 to the head, which is small and rounded; on segment 12 is a short, stiff, rough horn with sharp point; the skin with eight subdividing folds to each segment, set with rough points; the colour either a dull grey-green or dull brown, with a darker shade of the ground colour along the middle of the back; a well-defined whitish subdorsal line, edged above with a rather darker tint of the ground colour; a subspiracular yellowish line, the spiracles black, the points on the skin white; the horn bluish at the base, yellow at the tip (Hellins). The dominating colour of *the fullgrown larva* is bright green, approaching celadon, the ground colour sprinkled all over with white dots, and with two lateral white lines one above the other, which descend insensibly from the head to the middle of the body, and then ascend slightly, one to the caudal horn, the other to the anal plate; after retaining these tints for some days, the larvæ were observed one morning to be of a beautiful vinous-brown tint, the dots remaining whitish, but the lateral lines changed to yellowish-red, this great change having occurred in less than 24 hours without

a change of skin (Réaumur). The larva is light or dark green or brown, densely covered with raised white dots. When fullgrown, it is 50mm.—60mm. long. At each side of the dorsum runs a longitudinal white or reddish line, above the legs a light or dark yellow stripe, above which stand the black spiracles. A brown stripe in the middle of the dorsum may be either present or absent. The horn is bluish-green, brown, or blackish, at the apex either red-brown, yellowish, or black. Head of the same colour as body, rough, shagreened. Before pupation the larva becomes dirty brown-red (Bartel).

Variation of larva.—When rearing the larvæ of this species *ab ovo*, and also when rearing captured larvæ that have been taken very small, I find that after the second moult, the larvæ frequently turn a dark green in colour, almost black, but are quite healthy and produce perfect moths, although I do not take this aberration in the wild state; if it does occur wild it must be very rare (Ransom). Shortly before spinning up, but not in many cases before the larva has finished feeding, the whole skin area, with the exception of the coloured lateral stripe and the shagreen spots, darkens to a livid reddish-purple hue, against which the stripes and shagreen spots show up with great distinctness. This colour change (analogous with that which occurs in the larva of *Mimas tiliae*) gives the larva a repulsive snaky appearance, and the peculiar jerky method of crawling greatly aids in the sinister appearance of the larva. The description of the full-grown larva (*anteà*, pp. 11-12) applies to by far the greater proportion of some 50-60 larvæ collected in 1900, but a few examples showed striking variation in the ground colour. One larva had the ground colour of a much darker and more vivid green than usual, and a strongly-marked dark purple, almost black, mediodorsal stripe; the subdorsal stripe cream-coloured instead of white, strongly bordered above by the same dark purple tint as the mediodorsal, the spiracular band similarly bordered both above and below; a narrow dark medioventral stripe also present; the dark borders gave the pale bands a much greater intensity. Another larva varied somewhat similarly, but the darkening had progressed in this example until the whole ground-colour was dark olive-green, with the exception of a broad vivid green band on either side of the dark purple mediodorsal band. This form was the most handsome observed, the dark purple mediodorsal band with the bright green on either side making a striking contrast, whilst the sombre olive ground-colour of the subdorsal and lateral areas also showed up, in fine contrast, the subdorsal and spiracular bands and white shagreen spotting. One or two larvæ were even more extreme in the darkening, the whole ground-colour being of the darkest olive-green, tending to purplish in places; the head olive-brown (Bacot). Buckler figures (*Larvae*, etc., ii., pl. xxvi., figs. 2, 2*a*, 2*b*) three different forms of the adult larva: (1) Purplish-red dorsally and laterally to the bluish subdorsal line. (2) Brownish-grey with a dark brown subdorsal line. (3) Green, with a white subdorsal line. Sich observes (*Ent.*, xxv., p. 288) that he found a larva at Westgate, in July, 1892, of the dark-green form, which had the caudal horn curved downwards like that of the larva of *Sphinx ligustri*; the imago produced was rather dark, but otherwise normal.

Comparison of larvæ of Sesia stellatarum and Hemaris tityus.—The larva of *Sesia stellatarum* has a strong white stripe edged with distinct black above, where the subdorsal pale band is in that of *Hemaris tityus*. The caudal horn has a brown or yellowish point and black ring below in *S. stellatarum*. The latter also has a bright yellow flange line edged with dark above, the spiracles black with yellow spots within margin at top and bottom. It is also without the red lateral spots of the larva of *H. tityus*. The subsegments in both species appear to be the same, but in *S. stellatarum* each has a single row of largish white spots bearing minute hairs, 8 from spiracle to centre of dorsum; legs brown (Chapman).

Cocoon.—The larvæ in our possession have spun up on the surface of the ground, using almost any surface *débris* to mix with the silk. Réaumur notes that sometimes the larvæ go under the ground in order to make a cocoon in which to pupate, but others make one on the surface of the ground, composed of earth, pieces of leaves, or any branches of the foodplant or other plants that may surround them at the time (*Mém.*, ii., p. 276, pl. xii., fig. 2). The larva makes an open cocoon on the surface of the ground in which to pupate, and is usually sheltered by a plant or stone (Hellins); spins a very slight cocoon, sometimes among the foodplant, at others on the surface of the ground, using, whenever possible, grains of earth with the silk (Ransom); spins under moss in a slight cocoon with a few threads of silk holding the moss together (Lambillion); larvæ sometimes pupate naked on the surface of the ground (Burrows); the cocoon consists of leaves spun together on the surface of the ground; the pupa does not go over the winter, but produces an imago before the winter (Bartel).

Pupa.—Length 30mm.—35mm., width 8·3mm., somewhat flattened antero-posteriorly, and with an S curve well-marked, the 3rd and 4th abdominal segments (end of proboscis) and the flange of proboscis being prominent ventrally, and the mesothorax and 6th and 7th abdominal segments dorsally. The anal spine points a little ventrally rather than directly backwards. From the mesothorax to abdominal segment 6 the dimensions are much the same, thence to the anal extremity it tapers rather rapidly, the outline being convex. From the anterior extremity the measurements are, to end of proboscis 23mm., of 2nd leg 17mm., of antenna 15mm., of 1st leg 12mm. There is no trace of 1st femur. The proboscis keel round the front of the head, and rather flattened from side to side, gives a special facies to the pupa (in common with its allies). There is some depression on each side of the back of metathorax and 1st abdominal segments giving a definite "waist." The head, thorax and appendages may be described as very smooth and polished; the wrinkling of surface being so fine and delicate that one takes it at first for delicate colour shading rather than surface sculpture. A suture differentiates the brown part of the clypeus from the cheeks on either side, but there is nothing superficial to represent labrum, jaws or palpi. There is a very definite suture separating the scape of the antenna from the flagellum. The segmentation of the antennæ is indicated, but by very slight difference of surface. The wings show the neuration, the cell with median nervure, and the first eight nervures, the others are lost in costa. Poulton's line is very distinct on the fore

wings and also down the strip of hindwing. The (1st) spiracular opening is very narrow, with a very special dark raised posterior lip, the true spiracle is fully 1mm. deeper than this. The metathorax and hindwing are not quite as smooth as the forward portion of the pupa, and the narrow rugæ of the abdominal segments are well in evidence without being strong enough for the pupa to be called rough. Posteriorly (say on 8th) the sculpturing is by impressed dots, inclined to be in transverse rows, but with a strong suggestion of upholstering (*i.e.*, a cushion pinned down by buttons at regular intervals). Passing forward, the pittings are connected with fine depressed lines, and the fulnesses between seem rather fuller at their posterior margins, the whole, however, as a fine wrinkling, chiefly transverse. Such subsegmentation as there is, takes the form of a slight variation in the character of the wrinkling, and may be that and not definite subsegmentation. In front of the spiracles of 5th, 6th, and 7th abdominal segments, the surface slopes inwards, so that there is a slight angulation of surface, just anterior to the spiracles. This surface is not differentiated by sculpture except in front of spiracle on 5th segment, where it presents a number of small raised brown points in about ten rows between anterior margin of segment and spiracle. The rows are not very regular, or at most two or three of them are; they extend for about 6mm. along the segment, 8 or 10 points to 1mm., fading out at each end. Placed as transparent objects under a $\frac{1}{2}$in. compound lens, these dots look like cups facing forwards and partly flattened against the surface, partly buried in it. The same examination shows the general surface of the abdominal segments to have regularly scattered over it small tinted chitinous discs like coins or blood discs affixed. Amongst these are some that carry very minute bristles on a jointed base. These are very rare dorsally, abundant ventrally on 5, 6 and 7, less on 8 (abdominal). The anterior margin of abdominal segments, 5, 6, 7, has a narrow border sculptured (a little dimly perhaps) just like intersegmental membrane, and behind this is a border, little, if at all, sculptured, except by longitudinal (microscopic) striation. The first of these two structures is broad on each side of venter of 6th, and here carries several hair-points, the second is most marked in front of spiracles on 5, and here it carries several hair-points and hairs, as it does, but less abundantly, elsewhere. The horn scar is a doubtfully marked smoothed surface; microscopically it shows a crowded group of very minute dots, much massed centrally, looking like, and probably being to some degree, an aggregation of the skin points of the horn diminished in size, the points, except in size, resembling the discs elsewhere on the skin, and each with a suggested central hair-point. The scars of the prolegs have similar aggregations of skin points, but are differently arranged. There is, in the first place, a central clear area, then behind this 8 or 10 minute skin points, like abortive hair-bases, each surrounded by a large dark area, and sufficiently far apart for each area to be well developed. Then, just outside the clear area, is an aggregation of skin points of the same character in a dark clouded area, but so close together that the central 15 or 16 are within a space equal to one of the posterior dark clouds. The anal spike occupies the dorsal half of the end of the 10th abdominal segment, it

is 1·5mm. long, ·7mm. broad at base, smooth, and terminates in a fine point, that, seen under a lens, proves to be two fine points, slightly divergent. The anal scar has a rather swollen lip on either side, narrowing forwards. In the ♂ is a circle on 9th segment below, with a central longitudinal depressed line, the area between the circle and line full, but not very prominent*. In the ♀, the ventral line of 8, 9 and 10 presents no segmental division, but the surface runs smoothly from one to another, but without any suggestion of being obliterated by a smoothing force, drawing the posterior ones through it into 8. The 8th abdominal segment presents two pores with faintly tumid margins, one centrally, the other at its posterior margin. The colouring appears to vary, the general faint terra-cotta or very pale sepia tint has various dark or nearly black markings. The spiracles are dark, there is a dark line down the median suture of the maxillæ, and the anal spine is very dark. The wings have rows of dark marks down the interneural spaces, and similar dark markings occur on the other appendages. The space in front of the spiracle of the 5th abdominal segment, and the opposed surface of 4 is dark, and the whole abdomen is finely dotted with dark or black points, which are the fine hair-points already described (Chapman). Poulton figures and describes (*Ext. Morph. Lep. Pupa*, p. 205, pl. xx., figs. 24, 25) the terminal abdominal segments of the pupa of *Sesia stellatarum*. "Fig. 24 (×4) represents the last four segments of a ♀ pupa seen from the ventral aspect. The functional spiracles on the 7th, and the rudimentary spiracles on the 8th, abdominal segments are represented in profile. The posterior part of the pupa gradually tapers into the sharp black rostrum. The anus (A) is distinct. The chief peculiarity of the pupa is the remarkable distinctness of both the ♀ reproductive apertures. Although clearly seen in this figure, their relation to the segments is better studied on the more highly magnified fig. 25. Fig. 25 (×40) shows the median ventral area of the last three segments of the pupa, represented in the preceding figure. Of the very distinct reproductive openings, the anterior, leading into the bursa copulatrix, is seen to belong to the 8th abdominal, while the posterior, opening into the oviducts, apparently belongs to the 9th abdominal. The ventral prolongation of the boundary between the 9th and 10th abdominals is marked by a

* In most specimens the depression is rather deeper and wider than is implied by calling it a line, being rather a pore or pit. It seems always to be quite symmetrical, unlike the similar parts in Hemarids to which reference was omitted in vol. iii. In his papers in *Trans. Linn. Soc.*, 1890, pl., xx., fig. 26, Poulton figures these parts in a ♂ pupa of *H. fuciformis*, and calls attention to their asymmetry. Unfortunately, it would seem he had only one specimen, and with the characteristic caution of true science, merely notes it as that "of the individual represented." It is, however, present n all Hemarid pupæ examined (*Hemaris fuciformis*, *tityus*, *Cochrania croatica*, *kingii*) and probably in the whole subfamily. In these pupæ, the male tubercles are twisted so that the left one is more to the front, as well as a little larger and more prominent, and has a corresponding sinuation in the posterior margin of the 8th segment. The groove between them is of course rendered oblique, so that its anterior end points to the right instead of directly forward. The twisting probably depends on the ædœagus of the imago, being twisted so that the opening, instead of being ventral, is to the left side. The further asymmetry of the clasps in the Hemarids (see, *Trans. Ent. Soc. Lond.*, 1902, pp. 679 *et seq.*) is probably not represented in the pupa, unless it is by the sinuation of the margin of the 8th abdominal segment.

narrow median band prolonged from the area round the anus (A). The latter is very distinct. The surface of the pupa is everywhere marked by circles, with a dot in the centre of each, representing the (bristle-bearing) shagreen tubercles of the larva. The figure was drawn from a transparent object." The pupa is about 35mm. long, stoutest in the middle, tapering to the head, which is prolonged into a flattish projecting tongue-case; the abdomen tapers gradually to near the end, when it slopes off rapidly; it has a short sharp spike with two tiny straight spines at the tip; the pupal skin is thin, slightly shagreened, but showing some gloss; the colour dull drab, with the spiracles, wing-nervures, and a line on the belly from the head to the end of the wings, all dark brownish (Hellins). Elongate, lighter or darker brown in colour, with protuberant head. Sometimes the pupa is bluish-green, with a black-brown longitudinal stripe dorsally. The cremaster is slender and pointed (Bartel). The cremastral spine of the pupa of *Sesia stellatarum* is much more slender, and tapers more evenly than that of *Theretra porcellus;* it is also straight instead of curved, and appears to be bifid at the tip. There are no traces of a lateral dorsal ridge of spines on the 5th, 6th and 7th abdominal segments. The pupal envelope is very delicate, and would appear to be very badly adapted for passing an English winter in this stage (Bacot). The pupa turns black two days before emergence (Ransom).

Foodplants.—*Galium*, *Rubia* (Linné), *Galium verum*, *G. mollugo*, *G. aparine* (Raynor), *G. palustre* (Hamm), *G. saxatile* (Sich), *G. verum*, flowers preferred (Ransom), *G. verum*, seeds preferred (Guthrie), *Stellaria*, *Rubia tinctorum* (Bartel), *Epilobium* (Moeschler).

Parasites.—*Cryptus migrator*, F. (Marshall), *Alysia breviventris*, Gour. (Rondani), *Apanteles stellatarum*, Bé. (Rondani), *Apanteles glomeratus*, Linn. (Rondani).

Habits.—This is one of the most remarkable of the moths that visit this country. It has a distribution that covers the greater part of the Old World, and an ability to fly rarely witnessed in lepidoptera. It abounds in some of the hottest parts of its area, producing a continuous series of broods throughout the year, the spring examples of which often distribute themselves over the whole of the north temperate parts of the continents of Europe and Asia, where they increase during the summer in an incredible manner. Then for a series of years the species will be almost or quite absent. In 1865 and 1870, it swarmed locally in Britain, and was generally abundant throughout the whole of central Europe, Graeser observing that, in these years, the larvæ occurred in countless thousands in districts where, in other years, they only occurred singly. In 1872, again, it was also very abundant in Britain, and Newman refused (*Ent.*, vi., p. 112) to publish further records of its occurrence. In 1899, it also appeared in great numbers in most parts of the British Islands. The continuous-brooded habit is almost certainly the cause of its repeated extermination in the British Isles, for, although its very limited hybernating habit is sufficient to carry it through the short winter in southern Europe, allowing the ♀s to oviposit in February and March, our more severe winter not only kills off most of the hybernators, but our late spring probably does not allow of a sufficient advance in

vegetation for the larvæ produced from the eggs of the few successful hybernators to negotiate their early stages successfully. As to its hybernating habits, Bromilow observes that, to winter, the imagines enter dwelling-houses at Nice, and are often met with in disused clothing, etc. The species is, however, on the wing, in the Mediterranean district, practically all the winter, and the hybernating habit is there evidently a weak one. Mathew observes that, at Malta, it cannot be said to hybernate; it merely hides itself in holes in the countless stone walls, whenever a short spell of cold weather sets in, but is always to be seen any day throughout the winter when the sun shines. It may be said even to aestivate to a certain extent during the hottest time of the year at Malta, where everything is parched up, for it is then rarely seen in the public gardens at Valetta, and, on one or two occasions, it has been observed day after day sitting in dark passages in houses or dark corners of rooms. Walker records it as flying on Christmas Day, 1886, on the rock at Gibraltar, and further reports it as common there all through the year. Mathew also saw a pair, *in cop.*, there, on February 16th, 1866, when others were also noticed hovering about; Stainton observes that, in February and March, he has seen three or four moths buzzing in nearly every window of the Villa Borghese; Chapman notes (*Ent. Rec.*, xi., pp. 96—97) that, at Cannes, the species was abundant in February, 1899, the specimens in varied condition but usually somewhat worn, and he had no doubt that they had been on the wing on suitable occasions all the winter, whilst Fletcher records it at Crete and on the coast of Greece in November and December, 1900, and throughout January and February, 1901; at Kandahar, too, it is reported as very abundant in November, December, January and February. Further evidence of the slightness of the hybernating habit in the warm southern countries that the species inhabits will be found (*posteà*) when we discuss the time of appearance of the species. Such evidence as is forthcoming suggests that, if the species survives our winter at all, it has to do so in the imaginal state, yet the evidence of successful hybernation in this country is not very convincing. Three points stand out clearly, *viz.*—(1) Larvæ that feed up in September and October and pupate in October and November must produce imagines within a few weeks of assuming the pupal stage or die. (2) Imagines are found in houses, sheds, &c., during the early months of winter, showing that they attempt to do the amount of rest that may be necessary even in southern Europe, and possibly do successfully rest as long as they would ever have to do there. (3) Imagines are very occasionally found in January, February and March on sunny days in sheltered spots in England, as they might be (though much more abundantly) at the same time in Spain, southern France or Italy. As to the first point, our own evidence, supported by that of Hellins, Merrifield, Wells, Jefferys, Moss, and many other observers, is available; pupæ may live for a considerable length of time in the autumn beyond the normal three or four weeks usual for this stage, but they do not appear to be able to survive our winter. Moss curiously observes that late pupæ in his possession emerged quite naturally in November and December, 1897, without forcing, but that one sub-

jected to a forcing treatment died. As to the second point, we ourselves have frequently observed the imago in houses in the early part of winter. Fletcher has observed (Buckler's *Larvae*, &c., ii., p. 119) that he has seen many examples swept from an out-house in autumn mornings as though they had gone in for shelter through the coming winter. Haworth noted a specimen taken at Christmas, and suggested that the species hybernated in the imaginal stage; whilst Stephens observes that there are three broods of imagines in a year, in April, June and August, some of the latter brood having been known to hybernate. Newman states (*Ent.*, ii., p. 328) that the late-emerging imagines crawl into a corner of a breeding-cage or the cornice of a sitting-room and remain perfectly quiescent throughout the flowerless season. As to the third point, Shackell notes a specimen (*E.M.M.*, ii., p. 209), observed at Carmarthen, buzzing in a window on December 24th, 1865. Barrett records (*Ent.*, xxxiv., p. 21) six or seven examples coming into a house at Margate, during October, 1900, to hybernate, one being still in his bedroom in December, 1900; he offers no evidence for his statement (*loc. cit.*, p. 296) that there is only one brood, and that the imagines hybernate from October to May or June; Bartel, however, makes practically the same statement (*Die Palaeark. Gross-Schmett.*, ii., p. 216), *viz.*, that the moths emerge in Germany from July to October, hybernate, and are then found in May and June; Stainton also says (*Ent. Wk. Int.*, i., p. 21) that the imagines reappear in April after hybernation, as also do Horton and others, but without offering any evidence on the subject. Woodforde's note (*in litt.*) that he found an imago hybernating in a house at Taunton on February 2nd, 1860, and Willson's observation that he saw one flying in a room at Portslade on February 8th, 1894, afford much better evidence than is usually offered. Its appearance indoors must not, however, be altogether taken as proving hybernation, for Swinton states that, in Jerusalem, from March to June, at a time when the species is most active, it is frequently seen in sleeping apartments, which are usually more exposed to the sunshine than the sitting-rooms, and that imagines were frequently dislodged from the fringe of *Parietaria* that festoons the entrance to the numerous rock-hewn caves. He also adds that the imagines visit the vessels as they ride at anchor during the day off the Syrian harbours. The mere entrance into houses, therefore, is not altogether convincing evidence of intent to hybernate unless stay for some time can be shown, and Raynor notes the moths as especially abundant in the autumn of 1899, at Hazeleigh, both at mornings and dusk, the insects entering rooms in the evening for a safe resting-place till morning, and remaining pressed close up to the top of the wall where it meets the ceiling, and, in this position, not easily seen, whilst Grote observes that they repeatedly enter conservatories and houses at Hildesheim. A newly-emerged imago came into my room at Chamonix, on August 16th, 1902, and flew about the room for some time, and the same thing happened several times at Susa in August, 1897, but, when undisturbed, the moths soon found their way out again. Fowler notes (*Ent.*, xxvii., p. 143) the imagines as being very abundant in the house in the autumn of 1893, at Ringwood, flying against

windows, all the specimens being ♀s; but we have evidence that pairing in the south of France and in Spain takes place in very early spring, so that, if this were for hybernating purposes, ♂s also should be found. With regard to occasional imagines being seen on the wing late (and early) in the year, reference will show the appearance of imagines in the autumn, winter, and spring to be not uncommon, but we may here notice—November 19th, 1875, at Exeter, at fuchsia flowers (Hellins); January and February, at Gravesend (Clifford); a very good specimen captured at Southsea, November 27th, 1867, the weather cold and frosty but fine, it had been flying about the garden for a day or two before, and had eventually flown in at a window (Pasley); one flying actively along a stone embankment near Plymouth on February 13th, 1866 (Piffard); March 7th, 1866, on the wing at Budleigh Salterton (Thomson); April 18th, 1866, at Wareham (Fulford); imago emerged December 11th, 1887, at Clevedon, another seen flying along some palings in a sheltered spot at Bath, occasionally alighting and basking in the sunshine, on January 31st, 1898, in mild weather (Jefferys), January 3rd, 1899, at Hereford (Vaughan); January 27th, 1899, sent alive from Torquay (Prout); February 18th, 1899, at Winchester (Shepheard-Walwyn); March 20th, 1899, at Paul (Daws); April 2nd, 1899, at Weymouth (Peachell); November 24th, 1899, November 28th, 1900, at Truro (Rollason); February 28th, 1900, flew into a shop at Guernsey (Luff); April 12th, 1900, at Apuldram (Anderson); one flying along the Parade at a tremendous pace on April 3rd, 1902, a bright sunny day, at Torquay (Tutt). January 21st, 1865, freshly emerged in Paris (Fallou, *Bull. Soc. Ent. Fr.*, 1865, p. 5), February 7th, 1899, in room at Le Havre (Dupont), and February 12th, 1901, at Gembloux (Derenne), suggest much the same conditions for central and northern France and Belgium as prevail here. One taken inside a window on April 10th, 1900, in North London, slightly faded, but otherwise in very fair condition (James); April 13th, 1900, at flowers of *Aubritia* at Bognor (Fletcher); one beaten out of a bush at Bournemouth in February, 1902 (Robertson). It must be conceded that this is scant evidence to find as a result of search over the entomological periodicals for close on 40 years. Horton records (*Ent. Mo. Mag.*, ii., p. 165) that, in the autumn of 1865, he bred a second (autumnal) brood of this species out-of-doors. He further notes that he opened the abdomina of all the ♀s without detecting any eggs in them, and asks whether it is possible that the eggs develop during hybernation! We are inclined to ask whether the abdomina of any bred, unpaired, unfed ♀s, would disclose ova at any period of the year. It is the general opinion now among the most observant British lepidopterists that very few imagines of this species ever get through their hybernation safely in this country, less from extreme temperature than from long-continued periods of wet and cold. Walker and other first-class observers consider that the May and June examples, which usually presage a later abundance in this country, when, on rare occasions, it really is abundant here, are immigrants, possibly offsets from the multitudes that occur regularly in May in the hottest Mediterranean districts; these lay eggs that produce larvæ which, according to the season, are fullfed either in late June or early July, and the pupæ produce in due course imagines in July and August; these

lay, and the larvæ are fullfed in late August and September, some of the imagines emerging in October and November, although, in cold seasons, the bulk of the pupæ perish without disclosing their imagines. The number of imagines able to adapt themselves to the conditions of our winter must be extremely small. Of swift flight, the habit of this species of visiting ships at sea is well-known. We have already stated that Swinton notes that it visits the vessels during daytime as they ride at anchor off the Syrian harbours; Mathew observes that, when cruising in the Mediterranean, rarely a day passes without the moth being seen about the ship *(in litt.)*. He has recorded several examples seen about H.M.S. Hawke, on August 11th-16th, 1898, in the Mediterranean, from 25-80 miles from land, between Gibraltar and Leghorn; also seen every day on the ship in the Mediterranean whilst going from Gibraltar to Malta, and, on August 25th, two days before reaching Plymouth, one was observed flying about the ship. An imago is also noted as being observed on a steamboat several miles off Ramsgate, August 30th, 1856 (Powell). We have ourselves seen imagines flying at a tremendous pace over the summit of the Little St. Bernard Pass in August, and, on the topmost point of the Col de la Croix, at some 8000 feet elevation, this was one of the species met with, in what may be described as a rocky wilderness. Its ability to fly an immense distance in a short time is known to every one. The amazing rapidity of its flight, its share in the cross-fertilisation of flowers, and its remarkable habit of flying up and down walls and rocks quite devoid of vegetation are equally well known. Fletcher observes *(Ent.*, xxxiii., p. 129) that the sound made by the wings when poised over a flower on a hillside at Wei-hai-wei was very audible, reminding one of a *Bombus*, but louder and deeper, whilst Anderson notes *(Ent.*, xxxii., p. 306) that he heard a specimen on rapidly-vibrating wings, at the plants in a conservatory making a loud humming noise, considerably louder than that of a humble-bee. Ransom and others have confirmed this statement, and Oldham records that he observed the imagines, from early morning until 7 p.m., at jessamine, honeysuckle, and geraniums, from September 1st—14th, 1899, at Wisbech S. Mary, the hum of their rapidly-vibrating wings being audible at a distance of several feet, and that, during flight, the long proboscis appeared to be always fully extended, whilst rain seemed to affect them but slightly, as, on two wet days, they were seen busily probing the geraniums for nectar during sharp showers. Shaw observes that he watched a moth on the wing, its wings vibrating so rapidly that they could scarcely be noticed to move at all, the long hairs of its body standing out straight along each side and across the posterior of the body, and states that it inserted its tongue, which protruded an inch or more, into flowers whilst on the wing, showing particular preference for a certain kind of flower—in this case a cream-coloured *Viola*—ignoring all others, and systematically visiting every flower of this colour in a row ten yards long, missing only those flowers the edges of the petals of which had commenced to turn up, but staying at many a flower that was fully open or had commenced to open. Müller states *(Fertilisation of Flowers*, p. 119) that *Viola calcarata* greatly surpasses *Viola tricolor* in the size of

its flower and the length of its spur (13mm.—25mm.), and is fertilised only by lepidoptera, chiefly by *S. stellatarum*, which has been observed to visit 194 flowers on different plants in 6¾ minutes, and to crossfertilise them by means of its proboscis dusted with the white pollen. Other flowers fertilised by this species are *Dianthus carthusianorum*, *Œnothera biennis*, *Echium vulgare*, *Ballota nigra*, *Nepeta glechoma*, *Erythraea centaureum*, *Syringa vulgaris*, *Onopordon acanthium*. As to the selection of certain coloured plants on particular flights, Perkins observed hundreds of specimens at phlox at Wotton-under-Edge, in 1858, those individuals that visited the phlox never going to the petunias and *vice versâ*. The variety of flowers visited by *S. stellatarum* is really legion; it is said to prefer *Saponaria*, *Echium*, petunias and geraniums in Indre (Martin), *Syringa*, honeysuckle, *Sambucus nigra* and *Antirrhinum linaria* in the Baltic Provinces (Nolcken), phlox, in Thuringia (Krieghoff), red-flowered *Galeopsis* in Nassau (Rössler), *Echium* and *Salvia pratensis* in the Grisons (Zeller), swarming at flowers of *Echium vulgare* at Cuxton, Deal, Fontainebleau, Reading, &c. (Tutt), at red valerian at Bath, and dahlias at Tullylagan (Greer), at honeysuckle at Reading (Nash), petunias, geraniums and verbenas at Enfield (Edelsten), geraniums and lavender at Buckerell (Riding), honeysuckle and turncap lily at Carlisle (Day), tropæolum at Great Grimsby (Dawson), rhododendron at Cambridge (Freeman), sweetwilliams at Chatham (French), white arabis at Brighouse (Blakeborough), wallflower and lilac (Haggart), privet blossom at Deal (James), geraniums and petunias at Namur (Colignon), flowers of *Centranthus ruber* at Morthoe in August and September, 1883 (Riding), *Echium vulgare* in July, 1883, at Deal and Dover, in the evening and again in the early morning sunshine (Coverdale), bugloss as late as 8.30 p.m. (Poulton), exceedingly abundant at *Echium*, in 1893, at Reading (Hamm), and at Portsdown Hill (Pearce), several visited honeysuckle on two or three moonlight nights in succession at Ilfracombe (Smith), at honeysuckle in the middle of September, 1872, came after dark, as well as at twilight and dusk (Corbin), at phlox, at Chagwood, at dusk (Jefferys), at petunias at Forres (Norman), in hundreds at red valerian in July, 1893 (Johnson), at petunias about 6.15 p.m., at Kilburn (Bergman), at pansy blossoms at Haslemere, and, on October 23rd, 1899, at 7.30 a.m., one was observed at petunias, although the weather was dull and gloomy and there was a soaking dew (Newman), extraordinarily abundant at valerian in early July, 1892, on the 5th, numbers at the blossoms in the pouring rain, at Lynton (Cooper); at pinks, pansies, and *Aubritia* till the white phlox opened, then the other flowers were neglected (Armitt). Mathew notes that at Malta, in the Floriana Gardens, one afternoon in 1897, he saw more than a hundred flying before the flowers of a small evergreen privet, and states that they also seemed very partial to flowers of *Lantana;* valerian at Weston-super-Mare (Hudd), pelargoniums at Worcester (Rea), *Escallonia* at Lynmouth (Briggs), jessamine at High Wycombe (Peachell), red valerian at Sulby (Clarke), valerian, at dusk, at Emsworth (Christy), phlox at Reading (Holland), violets and crocuses at Budleigh (Thomson), larkspur at Kensington (Stevens), lucerne at Beachy Head (Colthrup), heather at Bath (Jefferys), flowers of lilac and wall-

flowers in hundreds, in June, 1899, at Galashiels (Haggart), rhododendron at Bettws-y-Coed (Bland), *Allium ursinum* in Roslin Glen (Grimshaw), *Astragalus hypoglottis*, *Salvia verbenaca*, *Lotus corniculatus* between Burntisland and Kinghorn (Evans), eight at once on a small patch of vetch at Swanage (Kemp), *Ononis* at Yarmouth (Lockyer), fuchsias at Swanage (Hall), jessamine, red valerian, petunias, geraniums, bugloss, *Galium* and verbenas are mentioned repeatedly by various observers as being exceedingly attractive, although one suspects that the visitors to *Galium* are largely ♀s for the purpose of oviposition. Bower's observation (*Ent. Rec.*, xiii., p. 111) on November 6th, 1901, as to the way this species extracts nectar from fuchsia flowers is interesting; the flowers of fuchsia being pendulous it would be difficult, if not impossible, for the moth to insert its proboscis into the nectary in the same way that it does when feeding at those of geranium, verbena, &c., so it very cleverly thrusts it in through the small spaces formed by the tapering of the petals at their bases. Gatcombe records (*Ent.*, v., p. 146) that, whilst holding a flower of *Habenaria bifolia* near his face, a specimen hovered over it and inserted its proboscis in every flower, beginning at the bottom and going to the top in a spiral direction, &c., whilst Merrifield observes that a specimen flew to a flower of scabious in a lady's dress and searched every floret for honey, returning a second time before flying away. Haworth observed one flying in and out of a room to the flowers of white *Campanula* placed on a table in Hull. The moth appears sometimes to be attracted by colour; Vallette notes (*Ann. Soc. Ent. Belg.*, xxi., p. lxvii) a specimen flying into rooms to artificial flowers; exceedingly abundant at Angmering in 1899, hundreds might have been taken, and they appeared frequently to be attracted by colour, and were often seen hovering over the gaily painted tops of croquet sticks standing in the turf (Dollman), one attracted by a gaudily printed poster, at Gloucester, on which it rested some time (Merrin), one hovering over a brass door knob on which the sun was shining (Bartlett). The habit of flying up and down quite bare stone walls exposed to the sun, and occasionally resting thereon, is very remarkable. We once saw more than a score flying at one time up and down, in apparently the most purposeless manner, a bare stone wall outside one of the Savoy stations, probably St. Pierre d'Albigny, and occasionally resting under the coping, and they kept up their almost ceaseless journeyings up and down and along the wall, all the while we observed them. We have noticed them dozens of times, both in England and on the Continent, engaged in the same apparently purposeless pursuit. Norman says that, in July, 1865, the insect swarmed in Guernsey, large numbers settling on the walls and cliffs by the wayside, and, on one gravelly hillside, fully 30 specimens were seen in about five minutes; Evans records them as careering over the rocks of Arthur's Seat on June 19th, 1899; Chaumette stated that he had found them flying against walls exposed to the sun, and considered that they did so for the purpose of oviposition on the *Galium* growing in such situations; Eaton considers that the habit is due to the increased heat afforded by the walls. McLachlan has observed that the walls especially frequented are often those most free from any vegetable growth, except the lowest forms of lichens; and

Bond has watched the insect enter holes in walls, where it rested between its flights, and this observation has been confirmed by Wallace. Chapman notes it as frequently resting on rocks and stones, at Cannes, generally in shallow hollows where it is very inconspicuous, and as it remains there should the sun become obscured, it is probable that it hybernates, so far as it does hybernate, in such situations. Mathew also notices the habit of the moth in autumn to fly about the face of cliffs and walls, and twice he has seen it creep into holes. Jefferys notes (*Ent.*, xxxiii., p. 15) that the moths resting on walls depend on their similarity to their environment for protection, and records how, on the borders of Dartmoor, he was able to place his hand completely over a specimen that he observed to alight, and that it did not attempt to move till he touched it with his fingers. Robertson records the species as very common at Boscombe, in 1899, chiefly taken about noon, at rest on a stony bank, with the sun shining on them, few being attracted by flowers. Griffiths notes the species as common at Eastbourne, in 1892, often alighting on the hot bricks of walls in the sunshine, whilst, in 1899, on dull days, Sich observed the imagines at Malvern sitting on the rocks on three or four occasions, but it required a quick hand to box them; Merrifield has observed them flying about and occasionally resting on a wall at Cuckfield, and Watkins, in July, 1899, saw many at one time sunning on a favourite old freestone wall at Mumbles and on the seawall at Langland Bay, whilst Burrows has observed them flying at the brick walls of the houses in Hackney Road. Holland observed some at rest on a fence at Oxford, September 1st, 1893, and Briggs a swarm of more than 50, in 1865, flying over a burnt place on the heath at Crohamhurst. Rendall observed one, resting on a tarred shed in the sunshine, and on being disturbed it twice returned to a similar position before being captured. Clifford, French, and others (*Ent.*, ii., pp. 328—329) have noticed its partiality for resting on coal. Colthrup observes that he saw one at rest at noon, on August 14th, 1899, at Eastbourne, clinging to a piece of clothesline touching a wall, and looking like a knot in the rope. The imagines appear to emerge from pupa preferably in the morning, although some variation may be observed. Ransom notes 8.30 a.m. to noon, usually, however, between 9 a.m.—10.30 a.m. Merrifield has detailed a long series of emergences, 10 a.m., 10.30 a.m., before noon, before 1 p.m., 9.30 a.m., 11 a.m., 10.30 a.m., before noon, before 8.30 p.m., 11 a.m., 8 a.m., 8.30 a.m., 10 a.m., before 1 p.m., 11 a.m., 1 p.m. Two others emerged at about 3 p.m. and 4 p.m. respectively, the latter fully expanded at 5.30 p.m. Although the moth flies in the hottest sunshine, the condition of flight appears to be simply an adequate temperature, either of the air, in which case it will fly in dull weather or by night, or of direct solar radiation, when it flies at any time during the winter, at Cannes, when there is hot sunshine. We observed it in abundance until dusk visiting the *Salvia* flowers above Bobbie in August, 1901, and on several occasions in heavy showers, at Susa, Chambery and other places we have noticed the moths restlessly visiting geraniums and oleander bloom, quite undeterred by the weather. Merrin notes that, at Gloucester, he observed one hovering over jasmine in

August, 1865, whilst it was raining; Cooper notes it hovering over valerian in the pouring rain at Ilfracombe, July 5th, 1892; Waldegrave observed specimens hovering over flowers during a sharp shower of rain at Chewton Mendip. Daws observes that in 1899 he could have taken hundreds at the fuchsia flowers at Penzance; they flew chiefly from 8 a.m.—10.30 a.m., and again from 5 p.m. to dusk, fewer being observed in the middle of the day; Riding notes the moth as abundant in 1899, at Buckerell, preferring flowers of lavender and scarlet geraniums, a luxuriant bed of petunias being completely ignored, and states that they flew most freely in early morning and evenings; Gordon notes it as very abundant at Corsemalzie at rhododendron blossom between 3.30 p.m.—5.30 p.m., as many as seven being seen at one plant at the same time, but a few were also on the wing in the morning. Zeller also observes it as flying in the evening at flowers of *Echium* and *Salvia* in the Engadine. Mason's observation (*Ent. Record*, xii., p. 53) that the moths flew up and down outside a conservatory in their attempt to get at the orchid blossoms inside, suggests their being attracted by sight rather than scent. There are two records of its having appeared at light, Studd, on one occasion, took it in his light-trap at Oxton, and Blakeborough records one at light at 10.30 p.m., on August 2nd, 1900, at Brighouse. Oldham notes (*Ent.*, xxxii., p. 255) that, on August 24th, 1899, he saw one mobbed by sparrows. Little is known about the pairing of this species. Mathew notes that he saw a pair *in copulâ* at Gibraltar flying across one of the paths on the Rock, on February 16th, 1866, whilst many others were hovering about, and one suspects that, although, usually, pairing takes place soon after emergence in summer, the autumnal and winter emergences may put off the operation for some little time; feeding seems to be an absolute necessity for the development of the eggs.

Habitat.—To suggest habitats for this species is practically useless —the highest Alpine passes are traversed in a very short time, and the valleys are sometimes full of them; roadsides, woods, gardens, fields, hills, moors, fens, cliffs, and marshes are the haunts of this species, which we may meet anywhere. It even stays to sip the nectar from the flowers in the hands of the flower-sellers of Cannes and to extract its share from the flowers in the window-sill of a London garret.

Time of appearance.—In Britain, occasionally in January, February, March and April, often abundant in May and June, again in July-August, again in late September-November, and occasionally in December. In some years entirely absent, sometimes for several years in succession, in other years large numbers of immigrants appear in May and June, and spread all over the British Islands. In the southern and hotter parts of its range the species is continuously-brooded and has no real hybernating period, *e.g.*, the species is abundant all round the Mediterranean littoral, and, except for brief intervals between the broods, occurs all the year round—*e.g.*, in most parts of the Mediterranean littoral, particularly the western portion, such as the north African coasts, Spain, mid and southern Italy, Greece, Turkey, Asia Minor, Egypt and all the islands. At Malta, where most of the low-growing vegetation dries up during the summer months, it is very abundant during

the autumn, spring and early summer, and may be seen any bright day throughout the winter; wild flowers are most plentiful from the end of November to the end of March, and, about Christmas, various species of sweet-smelling narcissus are in flower in the various little rocky valleys that abound throughout Malta, and *S. stellatarum* is very partial to these. In gardens, the flowers of *Lantana*, *Plumbago* and evergreen privet are very attractive when they are out. I think the first ova must be deposited in October and then all through the winter, for I have seen larvæ full grown and quite small early in the year (Mathew). Mathew further gives *(in litt.)* the following table of observations recorded in his diaries, of course, a very small proportion of the whole, but still sufficient to give considerable food for reflection:—

Feb. 11th, 1862	Gibraltar	Many seen flying about the face of the rock in the hot sun.
Feb. 15th, 1863	Lisbon	Several flying about in the hot sun.
Nov. 12th, 1865	Malta	Ditto.
Feb. 16th, 1866	Gibraltar	In great numbers; a pair seen flying slowly *in cop.*
April 21st-24th, 1866	Malta to Gibraltar	Several seen flying about ship during passage.
April 28th, 1878	Mediterranean	At sea, 150 miles E. of Malta; many seen about ship.
May 24th, 1878	Sea of Marmora	Off Bulair Lines; noticed ovipositing on a plant on which was full-grown larva. *Cochrania croatica* also seen nearly every day.
June 13th, 1878	Gallipoli	Very numerous with *Cochrania croatica.*
Aug. 14th - Sept. 12th, 1878	Besika Bay	Numerous.
Oct. 13th, 1878	Artaki Bay	An example, still alive in the claws of a mantis.
Feb. 27th - March 24th, 1879	Malta	Seen frequently.
Oct. 17th, 1896	Salonika	Many seen at flowers of plumbago.
Jan. 3rd, 1897	Malta	Several; one of these moths probed the flowers of a bunch of narcissus, held in the hand.
Feb. 27th, 1897	Malta	Several.
Sept. 30th, 1897	Malta	Ditto.
March 11th, 1898	Platea	Unusually abundant. Flies in the dullest and coldest weather. Often found them in cabin at dusk; these commence to fly about as soon as electric light is turned on.

Other records are—November 1st, 1900, at Nauplia, November 19th off Crete, December 1st at Ayas Bay, January 30th, 1901, at Platea in Greece, February 18th at Zea, March 2nd, 1901, again April 26th to the end of May, abundant at Malta, July 26th, 1901, at Malta, &c. In 1902, observed at Malta, February 26th-March 1st, abundant, March 8th-12th, commonly, March 26th a few, May 13th, one or two absolutely fine, evidently the forerunners of a brood commencing to emerge, on May 15th-17th, a few were taken quite fresh, and May 24th one, common again August 18th-20th, then October 12th, abundant at the *Lantana* flowers (Fletcher); may be seen any fine day throughout the year along the Mediterranean coast, examples seen on Christmas day, 1886, on the rock of

Gibraltar (Walker), occurs all the year round at Gibraltar (Parry), common throughout the whole year in gardens, hills, and extending into the mountains in Italy (Cannaviello); throughout the year in the whole island of Sicily (Minà-Palumbo), flies throughout the year except for a few weeks at end of July and early August in Roumania (Caradja), very common everywhere in Bulgaria, in May, July-August, September-October (Bachmetjew), reported as being very abundant from November-February at Kandahar; common throughout the whole of the warm season at Wei-hai-Wei and Chifu (Fletcher), common February-early April at Tangier in 1868 (Blackmore), and from March-May, in 1866, at Rome (White), observed February 12th, 1901, at Gembloux (Poskin), in June-July and August-September at Namur (Derenne), also in October-November at Namur (Lambillion), October 2nd-8th, 1898, at Namur (Colignon), abundant from January-May in most years, in the Riviera, seen, *in copulâ*, on March 18th, 1899, at Le Trayas (Chapman), observed also October 12th, 1892, at Nice (Bromilow), May, August and early spring in Baden, an imago found December 31st, 1884, flying in street at Carlsruhe (Reutti), observed April 11th, 1898, at Chifu, and from May to November, 1898, very abundantly on Leu-kung-tao, also abundant April 22nd-25th, 1899, on mainland (Fletcher), April to June, 1897, at Alderney (Wells), imagines, eggs and larvæ all abundant on May 24th, 1878, at Gallipoli; seen every day, in August, 1883, at sea between Malta and Gibraltar, also August 25th at sea, two days before arriving at Plymouth, also common in June, 1898, at Canea and Suda Bay, several specimens netted on board ship August 11th-16th, 1898, between Gibraltar and Leghorn (Mathew), May-June and August-September, in Upper Austria (Himsl), May-June, also in August-September at Königsberg (Riesen). Odd dates have been noted as follows: June 18th-26th, 1897, at Fontainebleau (Tutt), June 19th-23rd, 1890, at Tancarville (Leech), June 22nd, 1887, at St. Ouens Bay (Walker), June 22nd, 1886, at Engelstein (Baker), average date, June 27th at Bergün (Zeller), swarmed in July, 1875, at Argèles (Distant), July, 1892, at Scheveningen (Walker), in myriads in August and September, 1877, at Tresco in the Scilly Isles (Crewe), September 10th, 1897, at Lyngör (Strand). British dates have been recorded as follows: August and early September around Nottingham (Leivers), abundant to September at Boscombe (Robertson), June, September and October at Chelmsford (Miller), seen flying in December and January at Gravesend (Clifford), abundant in 1818 and 1819, at Dover (Stephens), imagines September 8th-10th, 1846, July 10th-24th, 1847, August 31st-September 9th, 1847, common, larvæ on August 5th, 1847, pupated August 30th, commenced to emerge October 28th, 1847, August 4th, 1849; imagines began to emerge September 30th, 1857, and on the same date many were seen hovering over the geraniums in the college gardens, others emerged October 3rd, 4th, 7th, 8th, 12th, 13th, then every day from 15th-21st, 29th, November 3rd, 4th, 7th, 8th, 12th, 1857, the last for the year, at Brighton; August 3rd, 1857, at Cuckfield (Merrifield), July 31st, 1856, imago at Brighton (Image), August 1st-8th, 1856, at Shanklin, July 17th, 1857, on the slope near Headley Lane (Trimen), August 30th, 1856, off

Ramsgate (Powell), July 25th, 1857, at Ganarew (Langley), August 1st-4th, 1857, at Newhaven (Reeve), imagines emerged October 5th, 1857, from fullfed larvæ found at Ilfracombe beginning of September, 1857 (Mathew), May 29th, 1858, at the Lizard (Boyd), June 1st-7th, 1858, near Kilmun (Chapman), June 6th, 1858, at West Wickham (Healy), June 14th, 1858, rather common at Deal (Harding), June 15th-22nd, 1858, common at Folkestone (Drury), July 1st-13th, 1858, at Margate (Cox), August 1st-17th, 1858, common in London gardens (Stevens), common September 18th, 1858, at Newark (Gascoyne), June 2nd, 1859, at Kirriemuir (White), July 23rd, 1859, at Llandaff (Ollivant), common at larkspur, at Southport, week ending July 25th, 1859 (Hudson), August, 1859, common at Stoke Newington, July 2nd-October 21st, 1865, very common, May 31st, and September 7th, 1867, August 4th, 1875, June 29th-August 3rd, 1892, at Lee, June 24th, 1875, at Dartford, July 13th-September 28th, 1884, common July 19th-August 8th, 1889, very common from July 25th-August 6th, 1890, June 29th-August 3rd, 1892, at Deal (Fenn), scarce July 16th, 1860, at Deal (Harding), bred September, 1861, from larvæ found in August on *Galium verum* at Great Yarmouth (Harwood), June 26th-July 4th, 1865, at Chertsey, June 24th, 1870, at Maidenhead, June 24th, 1886, at Malvern, imagines June 3rd-September 11th, 1899, at Marlow (A. H. Clarke), from June to late autumn in 1865, none in 1866, at Kettering, July 3rd, 1865, at Crohamhurst, October 8th, 1899, at Lynmouth (T. Briggs), August and September, 1865, at Gloucester (Merrin), abundant October 5th, 1865, at Instow (Mathew), larvæ September, 1865, at Scarborough, pupated before the end of month, a dozen imagines emerged from October 11th in a cold room (Lighton), December 24th, 1865, a specimen at Carmarthen buzzing in a window (Shackell), February 13th, 1866, near Plymouth (Piffard), March 7th, 1866, on wing, at Budleigh Salterton (Thomson), only two observed in 1866, one on April 18th, the other in August at Wareham (Fulford), two only in Chatham district in 1866, one June 20th, 1866, at sweet-william, the other at Langley, Maidstone, although most abundant in 1865 (French), November 27th, 1867, captured at Southsea (Pasley), very abundant in June and again in mid-August, 1868, at Sheerness (Walker), August 14th, 1868, at Penzance (Cornish), bred September 1st, 1868, from larva found July 29th, 1868, also in July, 1899, abundant, at Painswick, also November 12th, 1884, from larva taken at Edge Hill on August 23rd, 1884, and which pupated August 30th; September 1st-13th, 1899, at the Mumbles and Langland Bay (Watkins), July, 1869, at Scarborough, August 11th-31st, 1893, at Morecambe (Porritt), imagines, July 18th, 1871, at Walton-on-Naze, common November 1st, 1886, at Brentwood, June 19th, 1892, July 10th-25th, 1893, at Rainham, June 3rd, 1899, June 16th, 1900, at Mucking (Burrows), September 1st, 1871, at Bulmershe Park, August 19th, 1873, at Burghfield, August 20th, 1875, at Whitchurch, September 7th, 1880, at Reading, September 17th, 1890, at Warren, September 1st, 1893, at Oxford, July 26th, 1898, at St. Helens (Holland), August, 1876, at St. Austell (Hodge), June 27th, 1878, July 3rd, 1879, at Rugby (Wilson), June 19th, 1879, at Torquay (A. H. Jones), June, 1879, in great abundance in Isle of Man hovering over rhododendrons, pinks and other flowers,

June 6th hovering over the flowers of holly at Lezayre, the scent from which is very strong, also July 10th, 1897, September 5th-11th, 1899, July 1st-16th, 1900, abundant at Sulby (Clarke), July 10th, 1883, at Lewisham, at geraniums (Douglas), plentiful 1884, absent in 1885, at Cork (Sandford), July 19th, 1884, July 6th, 1892, July 8th, 1893, June 15th, 1897, at Hayton, June 4th, 1899, July 18th, 1900, July, 1901, in Carlisle district (Routledge), July 23rd, 1884, at Hampstead, July 17th, 1889, at Deal, October 15th, 1899, at Maidstone (Watts), many throughout October, up to the 31st, 1884, at King's Lynn (Atmore), August 2nd, 1885, at Kingsdown, June 20th, 1899, and September 1st, 1899, at Croydon (Sheldon), September 1st-19th, 1885, at Lizard (Riding), July 21st, 1886, July 18th, 1887, September 20th, 1896, at Reading (Butler), larva, September, 1887, gave imago December 11th, 1887, in a cold room at Clevedon, also January 31st, 1898, flying in sunshine at Bath (Jefferys), July 10th, 1887, at Edinburgh (Evans), July 17th, 1887, at Moffat (Long), August, 1887, at Ilford (Tonge), August 7th, 1887, at Wednesfield (Hill), October 24th, 1888, July 10th-23rd, 1892, October 13th, 1893, August 12th, 1897, at Bristol, September 5th, 1892, at Braunton (Bartlett), October 14th, 1889, flew into house at Armagh (Johnson), 31 larvæ in various stages between September 1st-5th, 1889, in South Devon—4 died—27 pupæ, the moths all emerged between October 20th-November 26th ; July, 1898, at Sidmouth (Wells), May 31st-June 7th, 1890, at Brockenhurst (Ogden), August 3rd, 1890, to end of month at Mansfield, May 10th-July 16th, 1898, at Paul, seen as early as March 20th, but worn, also on August 3rd, again September 1st-30th, 1899, in 1900 continuously, from middle of July till late autumn, at Mansfield (Daws), May 25th, 1891, quite in centre of town, at Cambridge, May 5th, 1893, May 11th, 1895, May 20th, 1896, May 6th-22nd and September 10th, 1898, at Prescot (Freeman), July 3rd, 1891, at Leckhampton Hill (Goodlake), July 20th, 1891, at Cheltenham (Sanders), common June to October at Oxton, September 29th, 1891, August 25th and October 5th, 1892, September 13th, 1893, August 29th, 1896, June 19th, 1897, September 1st, 3rd and 8th, 1898, May 28th and August 14th, 1899 (Studd), June 2nd-9th, 1892, at Abbotts Wood and Eastbourne (Porritt), June 8th, 1892, at Worcester Park, July 9th, 1892, abundant in waste places in Jersey (Kaye), June 20th, 1892, and preceding days, October 23rd, 1899, at Haslemere (Newman), June 21st, 1892, June 16th and July 19th, 1897, June 7th-22nd, 1899, abundant, then again September 2nd-25th, 1899, 1892, worn, July 11th, 1894, August 25th, 1895, August 2nd, 1897, at Corsemalzie (Gordon), July 2nd-12th, 1892, at Eastbourne (Tugwell), July 3rd, 1892, at Crossgates, near Leeds (Nelson), very abundant at Lynton and Ilfracombe in early July, 1892, at red valerian, even in pouring rain, on July 5th (Cooper), July 8th, June 17th, 1898, fresh, all at Eastbourne, September 17th, 1893, at Ealing (Montgomery), July 26th, 1892, August 5th-September 9th, abundant at Swanage (Hall), July 26th and 27th, 1892, July 15th, August 29th, 1893, August, 1899, plentiful, August, 1900, a few at Sandown, January 27th, 1899 (sent up to me alive) end of July-August, 1899, plentiful at Torquay (Prout), eggs laid July 29th, 1892, at Hornsea, produced imagines November 1st and following days

(Inchbald), 1st week in August, 1892, at Folkestone (Byrne), abundant in August, 1892, at Eastbourne (Griffiths), August 3rd, 1892, August 15th, October 1st-2nd, 1893, at Panton, September 6th, 1893, at Halton, June 6th, 1897, June 8th-17th, July 20th, August 18th-23rd, 1899, at Hazeleigh, July 13th, 1899, at Little Baddow (Raynor), imagines, a few at Seaton, May 3rd, 1893, on August 18th, abundant, also on November 1st, 1900, at Seaton (Still), May 20th, 1893, in splendid condition at Manchester, June 20th, 1893, at Old Trafford (Stones), May and again October 11th-14th, 1893, at Harrow-weald (Brown), very abundant in June, 1893, at Barmouth (Johnson), June and July, 1893, very abundant, insect in all its stages at this time, at Reading (Hamm), June 27th, 1893, June 11th, 1899, July 15th, 1900, at Carlisle (F. H. Day), June 28th, 1893, June 10th, and again September 1st, 1899, at Southend (Whittle), July 1st, 1893, exceptionally abundant at Reading (Clarke), July 6th, 1893, abundant at Monks Wood (Blake), July 15th-24th, 1893, at Wicken (Mitchell), July 16th, 18th and 20th, 1893, at Wannock (Pearson), imagines August-September and October 8th-17th, 1893, at Southampton (Moberly), August and October, 1893, at Guildford (Grover), August 31st, 1893, several at Ashmore Woods, August 14th, 1900, at Sheerness (Fletcher), bred at Lewes September 1st, 1893, September, 1895, at Shoreham (Nicholson), September 3rd, 1893, at Kilburn (Bergman), September 22nd, 1893, at Mile End (McIntyre), October 2nd, 1893, at Sittingbourne (Hewett), very abundant in September and October, 1893, and still out October 23rd at Bournemouth (McRae), February 8th, 1894, flying in a room at Portslade (Willson), April 25th, 1894, at Kilberry (Cottingham), July 1st-21st, 1894, at Barmouth (Kenward), July 28th, 1896, a single specimen caught at Middlesborough (Lofthouse), August 14th-17th, 1896, at Bath, August 23rd, 1898, at Tullylagan, June 5th-20th, 1899, in hundreds on coast of Co. Antrim, a larva found August 7th, 1900, produced an imago in Co. Down, on October 5th (Greer), August 31st, 1896, at Stokesley (Gribble), June 21st-22nd, 1897, at Dinas Mowddwy (Tetley), June, 1897, at Aldershot, September, 1897, at Foscott, June, 1899, at Bettws-y-Coed (Bland), July 10th-24th, 1897, at Barmouth (Imms), August 24th, 1897, at Scilly, August 22nd, 1898, at Boscastle (Adkin), flying September 13th, 1897, September 19th, 1898, at Cambridge (Thornhill), September 18th, 1897, at West Kirby, September 19th-22nd, 1897, at Hall Road, two miles north of Waterloo (Moss), June 13th, 1898, &c., at Enniskillen (Allen), plentiful at Portland from August 20th till the end of September, 1898 (Hyde), September 10th, 1898, over flowers in daytime, June 14th, 1899, on wall of room at 10 p.m. (Barraud), September 18th-24th, 1898, at Lynmouth, July 11th-15th, 1900, at Llandudno (Cotton), September 24th-27th, 1898, April 2nd, 1899, June 2nd-14th, 1899, many in August, 1899, at Weymouth, April 6th, 1899, August 14th-September 5th, at High Wycombe, June 3rd-8th, 1899, many in August at Portland (Peachell), January 3rd, 1899, appeared at the supper of the Hereford Hunt ball (Vaughan), February 18th, 1899, at Winchester (Shepheard-Walwyn), April 12th, 1900, at Apuldram (Anderson), imagines swarmed in June and September, 1899, at Galashiels (Haggart), first appearance June 1st, in 1899, increased

to 20th, when it appeared to be very common, and generally distributed in Edinburgh district June 10th, 1899, between Burntisland and Kinghorn, June 15th, 1899, in the Isle of Moy, June 16th, 1899, between Longniddry and Aberlady, June 19th, 1899, near Blackford Hill (Evans), June 2nd, 1899, at Poyntzpass (Johnson), from June 3rd, 1899, in the Frensham district (Bingham-Newland), June 3rd, 1899, in Roslin Glen (Grimshaw), June 4th, 1899, at Thornaby, June 10th, 1899, at Great Ayton, July 21st-August 23rd, September 1st, 1899, at Linthorpe, June 16th, 1900, at Kildale, July 14th, 1900, at Great Ayton (Lofthouse), June 5th, 1899, first seen at Ringwood, extremely abundant later (Fowler), June 5th, 1899, on the Wallasey sandhills, imagines began to emerge August 21st, 1899, from larvæ taken at Broadstairs on July 12th, and which began to pupate July 20th (Eddrup), June 10th, August 30th, 1899, July 17th, 1900, but not often seen at Rugeley (Freer), June 10th, at Halliwell, another at Old Trafford, June 17th, 1899, hovering over some blue flowers in a lady's hat (Whittaker), June 13th, 1899, on into July, abundant at Reading, August 8th, 1899 onwards, at Bude and Boscastle (Reece), June 15th, 1899, in Breconshire (Jefferys), emerged July 29th-August 15th, 1899, exceedingly abundant the first week in September, and on fine days to be seen until November 4th, also on July 24th, 1900, at Sudbury, and September 28th-October 17th, 1901, in the Sudbury district (Ransom), from August 1st to end of October, most abundant 1899, at Llanstephan (Bingham-Newland), August 1st-September 11th, 1899, at Swanage (Kemp), August 3rd-10th, September, 1899, July 17th, 1900, at Worcester, August 12th-23rd, 1896, at Dawlish (Rea), August 4th, 1899, at Malvern, August 17th, 1899, at Stratford-on-Avon, August 23rd, 1899, at Eastnor Castle, September 2nd, 1899, at Chiswick, July 16th, 1901, at East Hoathly (Sich), August 10th-27th, 1899, at Eastbourne, August 20th, 1899, at Herne Hill (Carr), August 14th at Eastbourne, September 17th at Beachy Head, September 30th, 1899, at East Dulwich (Colthrup), August 13th, 1899, at flowers of *Weigelia coccinea* at Ulverston (Petty), last week in August and first week in September at Eastbourne, mid-July, 1899, at Shoreham, near Brighton, October 21st, 1900, at Paddington (Phillips), August 27th, 1899, at Lewisham, September 3rd, 1899, at Chattenden (Tutt), September 1st-14th, 1899, at Wisbech St. Mary, July 17th, 1900, at Siddington (Oldham), September 1st-2nd, 1899, in Hyde Park (Ent.), swarming at Enfield in September, 1899 (Edelsten), September 8th, 1899, at Sandgate, November 6th, 1900, at Uckfield (Bower), September 9th, 1899, many at Dover (Shaw), September 28th, 1899, at Luddenden Foot (Robertshaw), October 11th, 1899, in the city of London (Gresham Street) (Blenkarn), November 24th, 1899, November 28th, 1900, at Truro (Rollason), September 22nd, 1899, at Malvern (Edwards), imago early in February, 1900, in London (Ficklin), captured in North London on a window, April 10th, 1900, July 31st-August 2nd, 1900, at Deal, bred October 25th-November 4th, 1901 (James), April 21st, 1900, August 2nd, 1900, common at Brighouse (Blakeborough), June 4th-6th, 1900, at Newbury (Hopson), June 17th, 1900, at Lowestoft (Jenkinson), July 11th, 1900, at Kilmarnock, September 20th, 1900, at Glasgow (Dalglish),

July 15th, 1900, abundant at Box Hill (Turner), July 11th-August 3rd, 1900, at Rydall (Armitt), July 18th, 1900, at Lincoln (Mason), July 24th, 1900, at Milnthorpe (Stabler), July 24th, 1900, at Ripon (St. Paul), August 1st, 1900, at Ingleby (Elgee), August 9th-17th, 1900, common at Weston-super-Mare (Whittaker), larvæ at Margate on July 22nd, 1900, pupated, and produced imagines August 17th-19th (Russell), September 24th, 1900, at Chewton Mendip (Waldegrave), October 1st, 1900, at Kilburn (Walker), during October, 1900, six or seven came into house at Margate, one remained in bedroom until December; first imago in 1901, seen on June 21st, dozens early in July at Margate (Barrett), imagines September 16th, 1900, from larvæ obtained August 15th-27th, 1900, at Folkestone, September 21st-October 1st, 1900, at Ilford, October 2nd, 1900, at Wimbledon (Pickett), abundant in 1900 at Cranbrook, one as late as November 27th (Marshall), June 27th-September 21st, 1901, at Dorking (Oldaker), on the moors between Porlock and the Doone valley, August 9th, 1901, also on August 16th, 1901, at Lynton (Carr), imagines not seen before September 7th-8th, 1901, at Newick, but from the end of July into November in 1900 (Mackinnon), April 16th, 1902, at Reigate (Prideaux), June 28th, 1902, at Burnley (Clutten), August 15th, 1902, at Burgess Hill (Dollman).

LOCALITIES.—May occur almost anywhere from the most southerly to the most northerly, and from the most easterly to the most westerly points of the British Islands. ABERDEEN: abundant in some years from the coast up to 1500ft. at Braemar (Horne), Aberdeen (Traill). ANTRIM: on the coast, abundant in 1901 (Greer), Belfast (Watts). ARGYLL: Kilberry (Cottingham), near Kilmun (Chapman). ARMAGH: Armagh, Poyntzpass (Johnson). AYR: Kilmarnock (Dalglish), Cloncaird Castle (Anderson). BEDS: Biggleswade (Blake), BERKS: Reading, Maidenhead (Clarke), Pangbourne, Bulmershe, Burghfield (Holland), Hurst (Broome). BERWICK: Berwick (Shaw). BRECON: Brecon (Jefferys). BUCKS: Foscott dist. (Bland), Marlow (A. H. Clarke), Halton, Wavendon (Stainton), High Wycombe (Peachell), Buckingham (Slade). BUTESHIRE: Arran (McArthur). CAMBRIDGE: Fen district, abundant (Balding), Wickeu (Mitchell), Cambridge (Farren), Wisbech St. Mary (Oldham), Ely, Bottisham, common (Jenyns). CARMARTHEN: Carmarthen (Jefferys), Llanstephan (Bingham-Newland), Langharne (Kaye). CARNARVON: Bettws-y-Coed dist. (Blaud), Abersoch (Martineau). CHESHIRE: general on the coast sandhills, Wallasey sandhills (Eddrup), Cheadle (Masefield), Alderley Edge, Wilmslow, Siddington (Oldham), Winningtou dist. (Lucas). CORK: Cork (Sandford), Courtmacsherry, common, Timoleague, Ummera Woods (Donovau), Mallow, scarce (Bingham-Newland). CORNWALL: Tintagel, common (Sheldon), Boscastle, Scilly Isles (Adkin), Tresco (Crewe), Bude (Reece), Lizard (Riding), St. Austell (Hodge), Paul, Penzance (Daws), Truro (Stainton). CUMBERLAND: uucertain, abundant some years (Day), not uncommon on the coast (Mawson), Keswick, seldom seen (Beadle), Lake district (Staintou), Carlisle, Silloth, Salkeld, Penrith, Maryport (F. H. Day), Haytou, Castle Carrock (Routledge). DENBIGH: Denbigh (Walker), Llandudno (Cotton), Llanrwst (Bairstow), Ruthin (Ward), Bettws-y-Coed dist. (Bland), Colwyn Bay (Whittaker). DERBY: southern parts, common (Payne), Burton district, abundant some years (Payne), Middleton Dale (Alderson), Bakewell (Fuller), Staveley district (Hooke), Burton-ou-Trent (Staintou), Ashbourne, abuudant some years (Lightou), Derby (Pullen). DEVON: Oxton, common, sometimes abundant (Studd), South Devon (Wells), Lynton (Carr), Seaton (Still), Budleigh-Salterton (Thomson), Lynmouth, Ilfracombe (Cooper), Instow, Barnstaple, Braunton Burrows (Mathew), Torquay (Prout), Sidmouth (Raynor), Buckerell, common some years (Riding), Dartmoor (Gummer), Newton Abbot (Holdaway), Dawlish (Rea), Exeter, Teignmouth, Plymouth (Stainton), Morthoe, Bideford (Longstaff), Devonport (Hayward), Lundy Island (Chase), Chagwood (Jeffreys). DONEGAL: Derry district (Campbell), Ballyshannon (Johnson). DORSET: Portland (Partridge), Wareham (Fulford), Poole (Wanhill), Swanage (Hall), Weymouth, (Blackmore), Dorchester (Stainton), Glanvilles

Wootton (Dale), Ashmore Woods (Fletcher), West Bournemouth (Robertson), Lyme Regis (Charles). DOWN: Lisburn, Newcastle, White Mountains (Watts). DUBLIN: Dublin (Kane), Blackrock (Greer), Kingstown (Kane). DUMFRIES: Moffat (Long). DURHAM: uncertain in the Durham district (Maddison), Hartlepool, sometimes abundant, Durham, common (Robson), Darlington (Stainton), South Shields (Eales), Axwell (Hedworth), Barnard Castle (Lees), Seaton Carew (Sang), Tow Law (Fawcett). EDINBURGH: Edinburgh (Stainton), Buckstone Farm near Edinburgh (Evans). ELGIN: Elgin (Brown), Forres (Norman), Strathspey (Moore). ESSEX: coast districts, sometimes common (Harwood), Ilford (Tonge), Chelmsford (Miller), Hazeleigh, Little Baddow, Maldon (Raynor), Mucking, Wanstead, Brentwood, Rainham, Walton-on-the Naze (Burrows), Harwich, Weeley (Mathew), Sudbury dist., Henny (Ransom), Leigh, Benfleet (Whittle), Epping (Stainton), Frinton (Bacot), Leyton district (Meldola), Southend, common (Vaughan). FERMANAGH: Enniskillen (Allen), Tempo (Kane). FIFE: Falkland, between Burntisland and Kinghorn (Evans). FORFAR: Kirriemuir (White). GALWAY: Galway (Barrett), Connemara, common (Birchall), Clonbrock (Allen). GLAMORGAN: Langland Bay, Swansea (Robertson), Llandaff (Ollivant), the Mumbles (Watkins), Glamorgan (Llewelyn). GLOUCESTER: generally distributed, not often abundant (Hudd), Micheldean (Searancke), Gloucester (Merrin), Painswick, Edge Hill (Watkins), Leckhampton Hill (Brooke), Stonehouse (Nash), Bristol (Tibbs), Lower Guiting (Stainton), Clevedon (Mason), Weston-super-Mare (Crotch), Cheltenham (Robertson), Almondsbury (Porritt), St. Briavels (Pashell), very abundant, Stroud, Upton-on-Severn (Redmayne). HADDINGTON: between Longniddry and Aberlady, Craiglockhart (Evans). HANTS: New Forest (Cox), Burghclere district (Alderson), Brockenhurst (Ogden), Ringwood (Fowler), Portsdown Hill, Cumberland Fort, Portsea, Gosport (Pearce), Bournemouth (Robertson), Boscombe, Aldershot (Bland), Winchester (Holdaway), Wishanger (Bingham-Newland), Southampton (Moberly), Lyndhurst (Stainton), Isle of Wight—St. Helens (Holland), Shanklin (Trimen), Sandown (Prout), Totland Bay (Sich), Ventnor (Guyon), Newport (Moberly), Kimpton (Rudd). HEREFORD: Hereford (Anderson), Leominster (Hutchinson), Tarrington (Wood), Eastnor Castle (Sich). HERTS: Broxbourne (Bacot), Much Hadham (Bingham-Newland), Hertford (Stephens), Hitchin (Griffith), Tring—the Chilterns (Tyrer), Bushey Heath (Barraud). HUNTS: St. Ives (Norris), Monk's Wood (Blake). ISLE OF MAN: in great abundance in all parts in some years—Lezayre, Douglas Head, Castletown, Douglas, Ramsey, Sulby (Clarke). KENT: Longfield, Gravesend (Jennings), Chatham district, Langley, Maidstone (French), Sandwich, St. Margaret's Bay, common (Shepherd), Ramsgate (Willson), Dover (Walker), Folkestone (Byrne), Westgate (Sich), Margate (Cox), Strood, Cuxton, Chattenden, Lewisham (Tutt), Bromley (Turner), Sandgate (Bower), Deal (Harding), Rochester (Chaney), Herne Bay (Butler), Lee, Dartford (Fenn), Cranbrook (Marshall), Tenterden (Stainton), Kingsdown (Sheldon), Sheerness (Fletcher), Broadstairs (Eddrup), Walmer (Griffiths), Sittingbourne (Hewett), Erith (Sabine). KERRY: Killarney (Kane). KIRKCUDBRIGHT: Douglas (Robinson). LANARK: Glasgow (Dalglish). LANCASHIRE: general on the coast sandhills (Moss), fairly common in South Lancs (Ellis), common in North Lancs (Murray), Manchester (Stones), Burnley dist. (Clutten), Halliwell, Old Trafford (Whittaker), Southport (Hudson), Preston (Stainton), Prescot (Freeman), Crosby coast and sandhills, Prestwich, near Grange (Ellis), St. Helens (Thompson), Ulverstone (Petty), Morecambe (Porritt), West Kirby, near Waterloo (Moss), Blackpool (Mosley), Bolton (Johnson), Lytham (Hodgkinson), Liverpool district (Harker). LEICESTER: fairly common—Buddon Woods, Quorn, Loughborough, Gumley, Leicester, Kibworth (Bouskell). LINCOLN: Lincoln district, occasionally (Carr), Cleethorpes (Auld), South Park (Musham), Grantham, Brant Broughton (Stow), Great Grimsby (Dawson), Panton, Hatton (Raynor), Woodhall Spa, Horncastle, Thornton (Walter), Wyberton, near Boston (Lane-Claypon), near Lincoln (Burlow). LONDONDERRY: Derry (Campbell). LOUTH: Castle Bellingham (Thornhill). MERIONETH: Barmouth (Johnson), Dinas Mowddwy (Tetley), Harlech district (Graves). MIDDLESEX: Harrow district, common (Rothschild), Kilburn (Bergman), Highbury (Hodge), Chiswick (Sich), Mill Hill, St. John's Wood (South), Ealing (Montgomery), Kensington (Stevens), Islington (Smith), Tottenham (J. A. Clark), Harrow Weald, Oxhey Grove (Brown), Enfield (Edelsten), Mile End (McIntyre), Stoke Newington (Fenn), Kingsbury (Ficklin), Twickenham (Burrows), Hampstead (Watts), Paddington (Phillips), Isleworth (Myers), Waltham Cross (Bowles), Chelsea (Carr). MONMOUTH: Ganarew (Langley), Monkswood (Rea), Wye Valley (Vaughan). NORFOLK: King's Lynn (Atmore), Cromer (South), Great Yarmouth (Harwood), Norwich (Harris). NORTHAMPTON: Daventry (Green). NORTHUMBERLAND: uncertain, some years common

(Maddison), common, Jesmond (Robson), common on the coast (Maling), Newcastle-on-Tyne (Bold), Tynemouth, Cullercoats (Wailes), Dunstan (Hedworth), Twizell (Selby). Blyth Links (Hedworth). NOTTINGHAM: Newark (Gascoyne), Langford Moor (Carr), Chilwell (Pearson), Mansfield, not common (Daws), Wellow (Becher), South Leverton (Thornley), Nottingham (Leivers), Worksop (Alderson). OXFORD: Warren, near Reading, Whitchurch, Hardwick, Oxford (Holland), Foscott district (Bland), Adderbury (T. Briggs). PEEBLES (Evans). PEMBROKE: Pembroke (Barrett), Tenby (Robertson). PERTH: sometimes common, Perth, the Forth, Earn, Gowrie districts, Craigie, Kinnoull, banks of Tay and Almond (F. B. White). Balquhidder (Cameron). RENFREW: Gleniffer Braes, scarce (Paisley Nat. His. Soc. Record Book). ROSS: Isle of Lewis (McArthur), Contin (White). ROXBURGH: Hawick district, common (Guthrie), Caverton district (Elliott), Galashiels, sparingly (Haggart). RUTLAND; Uppingham (Bell). SHETLAND: Unst (McArthur). SHROPSHIRE: Ludlow (Rea), Shrewsbury (Stainton), Market Drayton district (Woodforde), Winnington district (Lucas). SOMERSET: North Somerset, on the moors between Porlock and the Doone Valley (Carr), Shepton, Montague, common (Webster), Wellington (Milton), Castle Cary, frequent (Macmillan), Clevedon (Jefferys), Minehead Valley, Tauuton (St. John), Wotton-under-Edge (Perkins), Weston-super-Mare (Whittaker), Bishops Lydeard, Buckland Dinham (Mathew), Bath (Greer), Chewton Mendip (Waldeegrave), Limpley-Stoke, near Bath (Cardinall). STAFFORD: North Staffs, rare, not uncommon some seasons (Daltry). Wednesfield, Leek (Hill), Rugeley, Cannock Chase (Freer), Tixall, plentiful in 1893 (Bostock), Market Drayton district, sparingly, in some seasons only (Woodforde), Birchwood (Rea), Lichfield (Redmayne). STIRLING: Fintry (Eggleton). SUFFOLK: generally distributed (Bloomfield), Sudbury district, very uncertain (Ransom), Felixstowe, Needham Market (Mathew), Stowmarket (Stainton), Lowestoft (Jenkinson). SURREY: Guildford (Grover), Wimbledon Common (Clifford), Haslemere (Newman), near Headley Lane (Trimen), Chertsey (Clarke), West Wickham (Healy), Worcester Park (Kaye), Dorking district, common (Oldaker), Oxshott, Westcott, Horsley, Herne Hill (Carr), Box Hill (Turner), Purley, near Croydon (Fletcher), Crohamhurst (T. Briggs), Ripley (Stephens), East Dulwich (Colthrup). SUSSEX: Hastings, common (Bloomfield), Newick (Mackinnon), Shoreham, near Brighton (Phillips), Eastbourne (Thornewill), Chichester (Anderson), Portslade (Willson), Newhaven (Reeve), Lewes (Nickolson), East Hoathly (Sich), Burgess Hill, Angmering (Dollman), Brighton, Cuckfield (Merrifield), Rottingdean (Image), Wannock (Pearson), Worthing (Stainton), Abbotts Wood (Porritt), Apuldram (Anderson), Uckfield (Bower), Hove (Turner), Haywards Heath, Battle (Jenner), Bersted (Fletcher), Bognor (Lloyd), Fulking (Cardinall). TYRONE: Tullylagan (Greer). WARWICK: Stratford-on-Avon (Sich), Rugby (Wilson), Solihull (Martineau), Sutton (Harcourt-Bath), Birmingham (Imms). WATERFORD: Portlaw, common (Flemyng). WESTMEATH: Mullingar (Middleton). WESTMORLAND: not common, Witherslack, rather common (Murray), Coniston (Geldart). Kendal district, common (Moss), Milnthorpe (Stabler), Rydal, Grasmere, Ambleside (Armitt). WIGTOWN: generally distributed, but scarce—Corsemalzie (Gordon), Monreith (Morton). WILTS: Salisbury (Neale), Westbury (Knapp), Bremhill, Calne (Eddrup). WORCESTER: Malvern (Clarke), Worcester (Rea), Powick (Horton), Bockleton (Decie). YORK: distributed, not uncomuon, but uncertain in appearance (Porritt), York, Bempton, Speeton, Wilton, Bridlington (Hewett), Saltburn (I'Anson), Bishop Wood (Taylor), Brighouse (Blakeborough), Middlesborough (Lofthouse), Stokesley (Gribble), Huddersfield, Scarborough (Lighton), Hull district, very common, 1865 (Norman), Hull, occasionally (Boult), Barnsley (Harrison), Bradford (Carter), Bramham (Smith), Brantingham, very common in 1865 (Kington), Bridlington (Lawson), Flamborough Head (Horton), Redcar, Saltburn, Weeton, Hunslet, common (Pickles), Leeds (Birchall), Pannal (Roebuck), Pontefract (Hartley), Richmond (Harris), Selby (Foster), Sheffield (Doncaster), Spofforth (Aked), Wakefield (Talbot), Beverley (Johnson), Crosland Hall (Porritt), Pocklington (Leadman), Stanley (Charles), Sheffield (Cockayne), West Ayton (Hey), Ingleby (Elgee), Kildale, Glaisdale, Thornaby, Great Ayton, Linthorpe (Lofthouse), Redcar (Meek), Ackworth (Neale), banks of the Tees (Rudd), Nidderdale (Walker), Skipwith (Ash), Gormire, Kirkleby Park (Dobrée), Ripon (St. Paul), Doncaster (Paterson), Hornsea (Inchbald), Elland and Luddenden Foot (Robertshaw).

DISTRIBUTION.—The range of distribution of this species is remarkable, including the whole Palæarctic area, turning south at the eastern limit into China, and, according to Walker, extending to Tahiti in the Sandwich Islands. It covers the whole

of Europe (except the northernmost part, above 65° N. lat.), northern Africa, and Central Asia to Japan. Southward it reaches to 30° N. lat. (southern Japan—northern India), and in Africa below 30° (Canary Islands, which appear to form the most westerly point of its occurrence). The polar limits are marked by Scotland, Sweden, Finland, and the Amur district. The commonness of its occurreuce in the northern parts of the region fluctuates considerably, but its rare occurrence in the Amur district is remarkable, since it is noted as occurring very commonly in Japan. Bartel states that "into North America *M. stellatarum* has been accidentally introduced by shipping.*" Limit of elevation 8000ft. (Bartel). AFRICA: Azores (Godman), Madeira (Baker), Canaries (White), Tangier (Meade-Waldo), Teueriffe (Christ), Orotava (Alphéraky), Algeria, distributed throughout and not rare (Lucas), Collo, nearly all summer and throughout the autumn (Seriziat). ASIA: Asia Minor, the commonest lepidopteron (Zeller), Ayas Bay, Cyprus (Fletcher), Samsun, Amasia, Tokat, Diarbeker (Lederer), April at Asterabad and Tschehar-deh (Bienert), Palestine—Jerusalem, abundant (Swinton), northwest Asia Minor—Brussa, Olympus, the whole summer very abundant, Lydia-Maghnisa, Smyrna, Aidin; Cilician Taurus—Mersina, from the middle of February; The Taurus—Dorak, Gülek (Rober), Syria—Haifa, Angora; northeast Asia Minor, everywhere; northern Persia—Schahrud, Astrabad, &c., everywhere common; Transcaspian provinces—Kisil-arwat, Krasnowodsk, Mangyschlak peninsula (*teste* Bartel); Central Asia—Saisan, Lepsa (Staudinger), Kouldja district, to 3500ft., rare (Alphéraky), Achalzik (Christoph), Amurland—Wladiwostok, very rare, Sutschan, rare (Staudinger); Persia—Irak, swarms (Young), Askold (Oberthür), Govt. Tobolsk, Ural, and Turgai provinces; Turkestan-Thian-Shan, Pamirs, from end of February, up to 8000ft., but not common (Erschoff), Akmolinsk, Semipalatinsk provinces, Govt. Tomsk; Afghanistau—Kandahar, November—February, very abundant; Korea—Pung-Tung (*teste* Bartel); China—near Pekin (Bremer and Grey), Chifu, Wei-hai-wei, Leu-kung-tao, very common (Fletcher); Japan—general, Yokohama, common, Oiwake (Pryer), Nagahama, Nikko, Hakodaté, Nemoro, Foochau (Leech); northwest India—Quetta; Central India—Saugor (Alexander). AUSTRO-HUNGARY: throughout the Tyrol-Botzen, Mendelpass, Toblach, Cortina, &c. (Tutt), Ortler Alps, Trient (Bartel), everywhere in the Brenner district, up to 8490ft. (Galvagni), Lavantthal (Höfner), Upper Styria—S. Lambrecht (Ködermann), Upper Austria—everywhere, Pöstliugberg, Linz, &c. (Himsl), Lower Austria—Schneeberg, Vienna, Moravia—Mährisch-Trübau, Brünn, Ungarisch-Brod, Transsylvania, Nosàg, Kaschau, Rosenau, Neusohl, Zsadany, Bugganz, Raab, Oedenburg, Budapest, Debreczen, Grosswardein, Fünfkirchen, Mehadia, Orsova, Slavonia, Croatia, Dalmatia. Bosnia—Dervent (*teste* Bartel), Dalmatia—Island of Lissa, Great Pelagosa, Little Pelagosa; Bukovina, everywhere common (Hormuzaki), Pressburg (Rozsay), Bohemia—Carlsbad, Prague (Nickerl), Galicia, everywhere, but sparingly, in untold numbers, however, in the forest-region at Dora in August, 1886—Ternów, Lemberg, Brody (Garbowski), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Schneider), Raibl (Zeller), Taufers, Innsbruck (Weiler), Hermannstadt (Czekelius), Epiries, common (Husz), Hungary (Vángel), Bresztova, Kikulahegy, Drietoma, Kocsocz, everywhere common, Gölnitz (Hudák), Glockner, Fiume (Mann), Upper Carinthia, Salzburg, everywhere (Nickerl). BELGIUM: throughout (Lambillion), Frameries, common, Hasselt, Bomel, Jambes (Derenne), Gembloux (Poskin), Namur, common (Colignon), Rochefort (Carlier). BULGARIA: Sofia and district (Bachmetjew). CHANNEL ISLANDS: Guernsey, Alderney, Sark, common (Luff), Jersey, very abundaut (Kaye), St. Ouen's Bay (Walker). CORSICA: abundant (Marshall). DENMARK: distributed, not rare, sometimes in considerable numbers (Bang-Haas). FINLAND: Abo, Nyland, Karelia (Lampa). FRANCE: throughout (Berce), French Pyrenees (Oberthür), Hautes-Pyrenees—Argèles, abundant (Distant), Paris (Réaumur), Cannes, the Esterels, Monaco, Nîmes, Avignon, Digne, Larche, throughout Savoy—Aix-les-Bains, Chambéry, Chavoire, Annecy, Chamonix, Moutiers, St. Pierre d'Albigny, St. Michel-de-Maurienne, Bourg St. Maurice, Little St. Bernard, to over 7000ft.—Grenoble, the Arc Valley, Fountainebleau, &c. (Tutt), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir, very common (Guénée), Haute-Garonne, everywhere, also common at a high elevation (Caradja) Puy de Dôme (Guillemot), Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet) Doubs (Bruand), Aude, common (Mabille), Loire-Inférieure, very common (Bonjour), Saone-et-Loire (Constant), Seine-Inférieure, very common (Viret), Indre, extremely common (Martin), St. Quentin (Dubus), Deux-Sèvres (Maillard), Sarthe

* One would like to know Bartel's evidence on which it is concluded that *Sesia stellatarum* has been introduced into America by shipping.

(Desportes), Normandy—Tancarville (Leech), Brittany—Etretat (Reid), Boulogne (Timins), Le Trayas (Chapman), Nice (Bromilow), Paris district—Courbevoie, Forêt de St. Germain, Parc Maison Lafitte (Walker). GERMANY: everywhere (Heinemann), northwest Germany, generally distributed (Jordan), Rhine Palatinate (Bertram), Würtemberg (Seyffler), Giessen (Dickore), Lower Elbe district, common everywhere (Zimmermann), Waldeck (Speyer), Berlin district, common (Pfützner), Zeitz-on-the-Elster (Wilde), Munich (Kranz), Rudolstadt (Meurer), Mecklenburg, common some years, rare in others (Schmidt). Bremen, common (Rehberg), Saxon Upper Lusatia, not rare—Bautzen, Kamenz (Schütze). Dresden, common (Steinert), Thuringia—Erfurt, Gotha, nowhere rare (Krieghoff), Prussia—not common, Dantzig, Königsberg, &c. (Grentzenberg), Tapiau, Goldap, Gerdauen, Domnau, &c. (Riesen), Rastenburg (Klups), Upper Lusatia, everywhere common (Moeschler), Nassau, common (Rössler), Silesia, nowhere rare (Assmann), Pomerania, not rare (Hering), Alsace (Peyerimhoff), Wernigerode, in some years common (Fischer), Brunswick (Heinemann), Hanover (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), moorlands of the Upper Hartz, rare (Hoffmann), Crefeld and district, very abundant 1892, Hilden, Barmen, Elberfeld, common, Cassel, Halle, Leipzig, Wurzen, Kissingen, Ratisbon, Augsburg, Kempten, Frankfort-on-Main, Wiesbaden, Trier, Bavarian Palatinate (*teste* Bartel), Chemnitz (Pabst), Baden district, very common, Black Forest, to 3000ft., Constance, Carlsruhe, &c. (Reutti), Lübeck, common (Paul), Hildesheim, common (Grote). GREECE: everywhere — Acarnania, Attaca (Staudinger), Crete — Canea, Suda Bay, Theodore Island (Mathew), Corfu, Argostoli, Volo, Lemnos, Nauplia, Ayas Bay, Plataea, Zea Island (Fletcher), Navarino (de la Garde). ITALY: very common throughout (Curò), sometimes exceedingly abundant in the Alpine valleys—Susa, Courmayeur, Pré St. Didier, Aosta, Torre Pellice, Bobbie, above Au Pra to 8000ft.; Turin, &c. (Tutt), Modena (Fiori), Roman Campagna, very common (Calberla), Italian Riviera, Rome (Stainton), Riva dist., generally common (Jones), Lombardy, Piedmont, Liguria, Sardinia, both lowlands and mountains, Tuscany (*teste* Bartel), very common throughout, Sicily—Messina, &c., everywhere in February—Monreale (Minà-Palumbo). MALTA: general (Fletcher). NETHERLANDS: all provinces, not rare (Snellen), Breda, very common (Heylaerts), Schweningen (Walker). PORTUGAL: Lisbon (Mathew). ROUMANIA: everywhere throughout the year (Caradja), Jassy (Cosmovici). RUSSIA: Baltic Provinces, throughout (Nolcken), Moscow government (Albrecht), southwest Caspian district—Lenkoran (Radde), Crimea (Melioransky), Volga district, not frequent in Orenburg province, &c. (Eversmann). Transcaucasia, common everywhere—Derbendt, Tiflis, Alexandropol, Kars, Erzeroum (Romanoff). St. Petersburg—Mourino, Charbola, Lachta (Erschoff), govts. of Archangel, Oblonez, govts. Pskow, Mogilew—Gorki and Kiev, Podolia, Bessarabia, govts. Cherson, Jekaterinoslaw, Poltawa—Lubny, south coast of the Crimea — Alupka, govts. Orel, Kaluga, Tambow, Kasan, Simbirsk, Ufa, Ural district, Baschkiria, govts. Oreuburg, Samara, Saratov, Astrachan—Zarizyn, not common, Sarepta, &c. (*teste* Bartel). SCANDINAVIA: rare (Aurivillius), Scania, Blekinge, Smoland, Gothland, East Gothland (Wallengren), Norway, some years not rare — Christiania, Homansby, Haegdehaugen, Naes Vaerk, &c. (Siebke), Uplandia—Stäket (Sandahl), Upsala (Trybom), Lyngör (Strand). SPAIN: Andalusia—Cadiz, &c., everywhere common (Rambur), Galicia (Macho-Velado), Barcelona district, throughout (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao, common (Seebold), Gibraltar (Mathew), Granada, Ronda (Walker). SWITZERLAND: everywhere up to a considerable elevation, *e.g.*, on the Riffelberg, near Zermatt and the Albula Pass, near Bergun, at a height of 7000—8000ft. (Frey), Tuors Pensch, Bergün, Ober-Albula (Zeller), Weissenburg, common (Huguenin), Grisons (Killias), Dranse and Arve valleys (Baker), valleys of the Engadine (Pfaffenzeller), Bechburg (Riggenbach-Stehlin), Zurich, Dietikon (Dietrich), Canton Glarus, Andermatt at 4440ft., Engelsten (Baker), Thun (Forbes), Bernese Oberland (Jordan), Evolena (Tutt). TURKEY: Sea of Marmora—Bulair Lines, Salonika, Besika Bay, Artaki Bay, Gallipoli, very abundant (Mathew).

Subfam: EUMORPHINÆ.

Bacot insists most strongly that this group is, on larval characters, the most generalised of all the Sphingids, and that we have in it a division equal in value to all the rest of the Sphingids (see *anteà*, iii., pp. 365—366). Meyrick treats (*Handbook*, &c., p. 294) the group as a genus, uniting, under the name *Deilephila*, all our British species, which he diagnoses and tabulates as follows:

Tongue strongly developed. Antennæ less than $\frac{1}{2}$, gradually thickened to near apex, then pointed, apex slender, hooked. Abdomen smooth, broad, conical, pointed. Tibiæ with appressed scales.

1.	Basal area of hindwings black	2.
	Basal area of hindwings not black	6.
2.	Disc of hindwings rosy	3.
	Disc of hindwings yellow-ochreous	1 *porcellus.*
3.	Hindwings with black subterminal fascia ..	4.
	Hindwings without such fascia	2 *elpenor.*
4.	Forewings with anterior edge of pale band straight ..	5 *lineata.*
	Forewings with anterior edge of pale band irregular ..	5
5.	Edge of dark postmedian band reaching middle of dorsum	6 *euphorbiae*
	Edge of dark postmedian band reaching dorsum before middle	7 *gallii.*
6.	Forewings light brown	3 *celerio.*
	Forewings olive-green	4 *nerii.*

Bartel also includes (*Palaeark. Gross-Schmett.*, ii., pp. 52—58) the whole of the *Eumorphinae* in his genus *Deilephila*, and gives the insufficient reason that, to have divided it even into "the two natural groups into which the species fall," he would have had to make a change in the synonymy. He diagnoses these two groups as follows:

1. DEILEPHILA-GROUP.—*Larva* cylindrical, glabrous, reduced only slightly towards the head, otherwise of almost equal width throughout the whole length; the head moderately small but not retractile; a horn on the 11th segment (with the exception of *D. vespertilio*); rather brightly coloured, variegated with spots on the sides, varying considerably (*inter se*) in ground colour and markings (that of *D. vespertilio* is very constant in its characters). *Cocoon* on the ground, slight, between spun-together leaves. *Pupa* cylindrical with conical cremaster that terminates rather sharply; no projecting maxilla-sheath. *Imagines* with fairly uniform pattern on forewings (with the exception of *D. vespertilio*); hindwings red, black at the base, with black band before the border.

2. CHŒROCAMPA-GROUP.—*Larva* glabrous*, narrowed towards the head; usually on either side of 4th segment a large eye-spot, followed by similar spots on the side of the body; the thoracic segments more slender and capable of being withdrawn into the 4th segment; the first three segments elongate, in the form of a swine's snout; usually a horn on the 11th segment (occasionally wanting and then replaced by a horny wart-like elevation †); usually dimorphic, green and dark brown. *Cocoon* on the surface of the ground, coarse-meshed, composed of spun-together remains of plants and particles of earth. *Pupa* conical, anteriorly almost truncated; maxilla-case sometimes slightly prominent. Imagines very varied in colour and pattern.

He then gives the following table, which is evidently quite artificial, and only accidentally agreeing with natural affinities, for the differentiation of the species:

I. Antennæ always with a tuft of hairs at end.

A. Hindwings in the middle red, at the base black, and with a black almost obsolete band in marginal area.

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* The larva of *Deilephila syriaca*, a species which approaches those of *Smerinthus*, is, according to Lederer, not glabrous but rough and shagreened (Bartel). Superficially on larval characters, this species appears to belong to an entirely different group of the Eumorphids, being far removed from the Eumorphid (*sens. strict.*) and Phryxid stirpes. It approaches the Sesiid and Hemarid larval forms in coloration and pattern, and is possibly one of the least specialised of all the Eumorphids, the Daphnid branch possibly intervening between it and the Eumorphids (*sens. strict.*) and Phryxids (Bacot). See also Weismann (*Studies in Theory of Descent*, transl. p. 191, pl. iv., fig. 29).

† This is not exact; the larva of *Theretra porcellus* has not a horny wart in place of the caudal horn (Bacot).

a. Nervures of forewings never white.

α. Forewings unicolorous slate-grey, with light, not prominent, spots on the transverse nervures; in the outer half of the wing with only traces of a blackish line, which sometimes disappear altogether. Head and collar externally margined with white—*vespertilio*, Esp.

β. Forewings with a distinct dark oblique band, which commences in a point at the outer angle, and ends broadly on the inner margin. Head and thorax broadly light-margined externally.

a. The light colour before the oblique band of the forewings is darkened with fine atoms, and passes gradually towards the middle of the wing into the darker colour of the costa.

1. Colour of costa and of the oblique band of forewings, as also that of body, dark olive-green. On the transverse nervure of the fore-wing stands a distinct black dot—*hippophaes*, Esp.
2. Costa and oblique band of forewings, as also the head, of a clay-yellow tint, inclined to brown. The small black dot on the transverse nervure of the forewings of preceding species is wanting or only finely indicated—*bienerti*, Staud.

b. The light ground-colour of the forewings forming a yellow or whitish band before the oblique band, sharply dark margined on both sides.

1. The red of the hindwings unicolorous. Antennæ above entirely white. Epaulettes always white-margined internally—*zygophylli*, Och.
2. The red band of the hindwings is, in the upper part, much lighter, whitish. Antennæ above dark olive-green, only at apex white. Epaulettes always without light margin to the inner side—*gallii*, Rott.

c. The light ground-colour of the forewings is not sharply defined inwardly, but mostly extends as far as the costa. The dark colouring of the latter projects in the middle as a large patch into the ground-colour.

1. Ground-colour of forewings (before the oblique band) white in the lower part. Red of hind-wings very light, inclining to yellow-brown. Underside of wings and body entirely without red colour, only with a hardly-perceptible reddish tinge in the middle of hindwings. Epaulettes internally white-margined—*mauretanica*, Staud.
2. Ground-colour of forewings never white. Red of hindwings very vivid. Underside of wings and body entirely covered with red. Epaulettes internally mostly not light-margined, or having also white or reddish inner margin—*euphorbiae*, Linn.
3. The oblique band of forewings much steeper than in *D. euphorbiae*, &c., &c.—*nicaea*, Prunner.

b. Nervures of forewings, excepting those of costa and basal area, mostly white. Epaulettes always interiorly with broad white margins.

α. Antennæ above white—*tithymali*, Bdv., *costata*, Nordm., *dahlii*, Hb.-Gey.

β Antennæ above dark olive-green with white tip. The abdomen in the incisions alternately black and white coloured. The red band of the hindwings unicolorous—*livornica*, Esp.

B. Hindwings at the base and inner margin red, with two black transverse bands.

1. Inner black band of hindwings interrupted before the inner margin. Abdomen on the sides of the first two segments with two black transverse spots—*osiris*, Dalm.
2. Inner band of hindwings not interrupted. Abdomen without black spots; segments 1 and 2 being occupied by the ground colour—*celerio*, Linn.

C. Hindwings without characteristic black transverse bands.

a. Abdomen with a tolerably broad uninterrupted golden-yellow band on either side.

1. Basal half of forewings beneath without black colouring. Abdomeu above with a double silver-white line with a metallic gloss in the middle, which, like the markings of the upper side of the forewings, stands out sharply from the ground colour—*oldenlandiae*, F.
2. Basal half of forewings beneath predominantly black. The central line of the abdomen very faint, indistinctly divided with dark in the middle, and of a yellow-browu colour; it does not stand out sharply from the ground colour like the markings of the upper side of forewings —*japonica*, Bdv.

b. Abdomen simply with a black spot on each side of the 1st segment. Hindwings black at base.

α. A black dot on the transverse nervure of forewings. Forewings eutirely brown in colour. Hindwings with light area above the inner angle—*boisduvalii*, Bugn., *alecto*, Linn.

β. Dot ou the transverse nervure of the forewings white. The forewings olive-coloured with red transverse stripes with violet gloss, costa of same colour. Hindwings in the outer half rose-red—*elpenor*, Liun.

c. Abdomen unmarked.

α. Hindwings iu basal area dull black.

1. Fringes at the end of the uervures much darker, especially distinct on the hindwings. Prothorax and epaulettes of the ground-colour of the body, the former not light-margined, the latter without white inner margin—*porcellus*, Linn.
2. All the wings very long and narrow in proportiou, with waved outer margin reddish-brown. The border of the hindwings above the inner angle much more emarginate. Prothorax and epaulettes light-margined on both sides—*askoldensis*, Oberth.

β. Hindwings with basal area not darker coloured than median area —*mongoliana*, Butl., *komarovi*, Chr., *davidi*, Obth.

d. Segment 6 of abdomen with a longish triangular dark green spot on either side. Forewings variegated with pale and dark green, white, reddish and violet. Hindwings at the base blackish, with double curved, narrow, light, transverse stripe beyond the middle. Epaulettes dark greeu, darker than the ground colour of the body. Prothorax and metathorax with a dark green longitudinal stripe - *nerii*, Linu.

II. Antennæ without tuft of hairs, gradually running to a fine point.

a. Margin of all the wings almost smooth, without tooth-like projections. Forewiugs cinnamon-browuish, with darker brown transverse stripes, of which the middle oue is very broad. Hindwings with dull black basal half, shading off iuto the cinnamon-brown externally. Body above with light median stripe commencing on the head and ending on the anus—*rubiginosa*, Brem. and Grey.

b. Margin of wings sinuate. Grouud-colour of forewings in the ♂ yellowish-brown, in the ♀ more red-brown,

with darker transverse stripes and bands. Hindwings almost unicolorous brown—*syriaca*, Led.

In considering the general appearance of the imagines there can be no doubt that *Hippotion celerio* is especially Sphingid *(sens. restr.)*, and it is also nearer *Sphinx* in the structure of the large proboscis and eyes; *Theretra porcellus* and *Eumorpha elpenor* are the least so; *Phryxus livornica* is more Sphingid *(sens. restr.)* than the two last-named. Separating *Daphnis nerii* (typical of a large tribe) as having markings very unlike the rest of the Eumorphids that we find in Britain, we find that the markings that cross the forewings show some method in their evolution, and this is no doubt to be correlated with different resting-habits. Taking *T. porcellus* with the oblique line from apex to anal angle and two transverse lines, one before and one beyond the middle of the wing, we find in *E. elpenor* a coalescence of the two outer lines into one reaching from the apex to the inner margin, and a second, almost median, line; then follow *Hyles euphorbiae* and *Celerio gallii*, then *Phryxus livornica*, and lastly *Hippotion celerio*. The advance is by the greater straightness and definiteness of the marking starting from the apex, and by its reaching the inner margin nearer and nearer the base. This is somewhat parallel to (1) Greater length of proboscis. (2) Larger eyes. (3) More dorsal position of pupal labrum.* There is the further stage beyond *H. celerio*, where the pupa has a horn. The loss of the larval caudal horn in *T. porcellus*, &c., must be looked upon as a specialisation †. The habits leading to this appear to have absolved *T. porcellus* from competing with the others as to proboscis, &c., but one cannot decide which is the higher of the two forms, specialised in different directions; probably one would suggest that an imaginal is higher than a larval specialisation. Without discussing the matter further, we have no doubt that we have, represented among the species taken in Britain, at least four very distinct tribes, which may be tabulated thus:

I. Tribe: EUMORPHIDI—*Theretra porcellus*, *Eumorpha elpenor*.
II. Tribe: PHRYXIDI—*Hyles euphorbiae*, *Celerio gallii*, *Phryxus livornica*.
III. Tribe: HIPPOTIONIDI—*Hippotion celerio*.
IV. Tribe: DAPHNIDI—*Daphnis nerii*.

In suggesting the above groupings we know we shall be met with at least one strong objection, *viz.*, that the larva of *Hippotion celerio* is nearer to those of the Eumorphids *(sens. strict.)* than to those of the Phryxids, but, judging from figures of the larva of *H. celerio*, one is inclined to doubt whether the resemblances are really fundamental. It is true that the larva of *Hippotion* has ocellated spots of a character similar to those on the larva of the Eumorphids *(sens. strict.)*, and so also, in a less degree, has the larva of *Daphnis nerii*, but there seems no real connection between the ocellated spots of *Hippotion*

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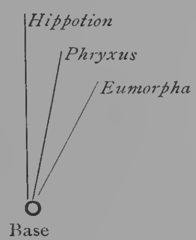
* These are, as pupal characters, to be correlated with the imaginal feeding-habits, *i.e.*, search for flowers at twilight and dusk requires large eyes; the long trunk is connected with feeding whilst hovering over may-be large and conspicuous flowers without alighting; the position of the pupal labrum is due to the modification of the tongue, and cannot well be considered as a separate character apart from greater length of proboscis (Bacot).

† The loss of the horn in *T. porcellus* has probably been due to the habit of hiding in crevices in the ground, where it would be very liable to injury (Bacot).

and *Daphnis*, although it may be noted that, whilst *Theretra porcellus* and *Eumorpha elpenor* have them on the metathorax and the 1st and 2nd abdominal segments, *H. celerio* has none on the metathorax, and *D. nerii* none on the 1st and 2nd abdominals. Although usually considered an Eumorphid *(sens. strict.)*, *i.e.*, a Chœrocampid, larva, that of *D. nerii* is wanting in the marked characteristics observed in *Eumorpha* and *Theretra*, and they appear also to be more or less absent in the larva of *Hippotion*, also usually considered a typical Eumorphid, *i.e.*, Chœrocampid, and certainly much more definitely so than is *Daphnis*. Sepp's figure *(Ned. Ins.*, viii., pl. 50) suggests, indeed, that the resemblance between *Eumorpha* and *Hippotion* is not so very real. The larva of the latter, also, has a lateral line on the abdominal segments, 3—8, in a line with the ocellated spots, and a very straight, long, slender caudal horn, but one cannot forget that the really closely-allied *Theretra (porcellus)* has no larval horn. *Hippotion*, of course, is not to be derived through the Phryxids (see fig.), and may, therefore, very well have resemblances to *Eumorpha* wanting in *Hyles*, *Celerio*, or *Phryxus*. In many characters, however, *Hippotion* has gone further from the Eumorphid *(sens. lat.)* base than the Phryxids, and the Phryxids than Eumorphids *(sens. strict.)*, whilst one recognises, of course, at the same time, that one can show characters in which the position would be reversed. Bacot is quite agreed as to the larval characters throwing *Eumorpha* and *Theretra* together, and is inclined to place *Hippotion* also on a more specialised branch of the same group, but separates *Daphnis* completely from the others, and suggests that it belongs to a more primitive branch of the Eumorphid stirps, although quite as specialised in its own particular features as are the other British genera in theirs. He considers it further removed from any other British genus than are, say, *Theretra (porcellus)* and *Hyles (euphorbiae)* from each other. The Phryxid species known to him, he considers, fall into an *euphorbiae-dahlii* group, *gallii-zygophylli* group, with *livornica* separate from either, and he adds that the larvæ forbid any association between the last-named species and *celerio* in spite of the broad superficial resemblance of the imagines.



The Eumorphid egg is very similar to that of other Sphingids, of a pale green colour, the shell transparent and slightly iridescent, almost smooth, and with little or no surface markings. Those eggs that we have seen have been small for the size of the moth, but there are no very definite characters to distinguish them from those of other Sphingids.

The Eumorphid larvæ are usually said to fall into two marked groups: (1) With the body fairly cylindrical and the anterior segments not markedly retractile—the Phryxid or Deilephilid group. (2) With the thoracic segments attenuated, drawn out to a point, and retractile within the 1st and 2nd abdominal segments, which are much enlarged —the Eumorphid or Chœrocampid group. In addition, the former is generally stated to carry longitudinal rows of striking spots, and to possess a warning coloration, whilst the latter has well-developed ocellated spots on certain of the segments. But there are

undoubted Eumorphid *(sens. lat.)* larvæ which do not well fall into these groups, and one suspects, therefore, that there are other groups which are fairly distinct in the larval stages from either of them, as there certainly are in the pupal and imaginal stages. Structurally, however, the Eumorphid larvæ appear (from those examined) to be very similar, and are particularly characterised by tubercles i and ii, on the meso- and metathoracic segments being placed in trapezoidal position and not closed up on the same subsegment as in the larvæ of other Sphingids. This is remarkable, and gives good ground for Bacot's contention that the Eumorphids *(sens. lat.)* are the most generalised Sphingids in the larval stage, and have a classificatory value equal to all the other Sphingids. His diagnosis *(antea*, vol. iii., p. 365) reads as follows:

Dorsal tubercles on meso- and metathoracic segments, set in trapezoidal (or oblong) form, i and ii being on separate subsegments; an enlarged 1st subsegment (consisting of 3 or more of the normal subdivisions); the caudal horn not always strongly developed; the hairs simple, hollow (not bifid).

The consolidation of iv and v on the 1st abdominal segment into a two-haired oval tubercle occurs in the first larval stadium of *Hyles euphorbiae*, and is very remarkable (it may be merely a specific and not a generic or tribal character, although one suspects the latter). The larva of *Daphnis* has a distinctive form and markings, and the position of the ocellated spot, on the metathorax and not on the abdominal segments, is of importance; its scheme of coloration suggests that it is protectively coloured as a tree- or bush-feeding larva, and not as one feeding on low plants and near the ground, where warning colours are predominant. Still one wants the young larva for detailed comparison. The consolidation of the first three subsegments of the abdominal segments, as one large subsegment, is also remarkable; it occurs at an early larval stage in *Eumorpha* and *Theretra*, and is noticeable in the later (almost adult) larval stage in *Hyles*, *Celerio* and *Phryxus*. The swollen 1st and 2nd abdominal segments of certain Eumorphid larvæ must not be confused with the tumid thoracic seg-

SESIID LARVA.	EUMORPHID LARVA.
1. Tubercles i and ii on meso- and metathorax arising from conjoined base, in 1st stadium.	i and ii on meso- and metathorax arising from separate bases on separate subsegment*, in 1st stadium.
2. Abdominal segments with subsegments 1-3 not united into an enlarged subsegment.	Abdominal segments with subsegments 1-3 united into an enlarged subsegment†.
3. Primary setæ in 1st stadium long and large.	Primary setæ in 1st stadium short and stumpy.
4. Primary setæ and secondary hairs bifid, in 1st and 2nd stadia.	Neither primary setæ nor secondary hairs bifid.
5. Secondary hairs situated on mammillary bases (=shagreen hairs), from the 2nd stadium to full growth.	Secondary hairs without (or with only slightly developed) mammillary bases; pigment round bases frequently markedly developed.

* This larval character separates the Eumorphids *(sens. lat.)* from all other Sphingid larvæ, and is, therefore, of great importance (Bacot).

† Varies in different species; it is most marked from the 2nd to the penultimate stadia in the Eumorphid larvæ (*sens. strict.*), and in the later stadia in the Phryxids (Bacot).

ments of certain Manducid and Sphingid larvæ. The differences between the Eumorphid *(sens. lat.)* and Sesiid larvæ are possibly best shown in the tabulation given herewith.

The habits of the Eumorphid larvæ are most diverse. The swimming ability of the larva of *Eumorpha elpenor* will be referred to in our account of this species. Young notes the occurrence of many larvæ of a non-British Eumorphid on a species of water-ranunculus at Mahdopoor in the Punjaub, which he came across while up to his knees in water snipe-shooting. Most of the Eumorphid larvæ feed on low-growing plants, a few only on shrubs.

The Eumorphid pupa is usually of a pale colour, and, in this respect, differs from those of other Sphingids. It is to be observed that the pupal structure appears to be somewhat at variance with the larval, for, whilst the larval peculiarities give a distinct line of cleavage between the Eumorphid and Sphingid larvæ *(sens. strict.)*, the Eumorphid pupal characters are definitely Sphingid *(i.e.*, not Amorphid). Chapman notes: The pupæ of the species examined, without being of delicate texture, differ from those of the other Sphingid groups in having a terra-cotta-colour, instead of the brown chitinous colour of *Sphinx* and *Manduca*, and that is familiar to us as that of underground pupæ, such as those of Noctuids. The terra-cotta may be much overlaid with black markings. It probably has relation to a habit of not going deeply underground for pupation, but of making a cocoon immediately below the surface, amongst rubbish, especially *débris* of dead leaves, &c., or, if a strict line be drawn, between solid earth and surface *débris*, not really burying themselves at all. We may recognise several types amongst them, though they are much alike in their general outline, the following being illustrative:

1. This pupa may be taken as the least specialised, it is smooth, *i.e.*, free rom any spines or flanges, but is very definitely sculptured with a wrinkled surface, the labrum is at the anterior extremity of pupa—*Hyles euphorbiae*, *Celerio gallii*.

2. This differs little from the former, except in one important particular, the development on abdominal segments 5, 6 and 7, of a row of small sharp spines, dorsally strong and towards anterior margin of segment, but laterally getting weaker, passing *behind* the spiracle, and absent ventrally. [The lateral position of these (*behind* the spiracle) shows they have nothing to do with the characteristic prespiracular flange of *Sphinx* nor with the anterior rows of spines, common in "pupæ-incompletæ." I have not myself seen an Eumorphid pupa with the prespiracular flange well-developed.]—*Eumorpha elpenor*, *Theretra porcellus*.

3. This pupa is much smoother than that of *Hyles* (*euphorbiae*), the wrinkles being very flat, or almost obsolete, the head very large, the carina of proboscis very strong, passing right round the front of the head, and making the labrum absolutely dorsal—*Isoples alecto*, *Hippotion celerio*, *Daphnis nerii*.

4. This presents another form, differing in the anal armature and in possessing a trace of the prespiracular flange, and in the proboscis having, not merely a strong anterior flange but, a long horn passing directly forwards and returning in a curving sweep, and dipping into and soldered to the ventral portion of the proboscis at the level of the prothorax—*Panacra vigil*.

It may be observed that *Thaumas vespertilio* has a pupa very little different from *Hyles euphorbiae*, suggesting that, in this case, the colouring of the larva indicates its affinities more truly than its want of horn. Considering how close many of the pupæ are, *T. vespertilio* might be pupally characterised as a separate genus, by having the wrinkling so modified that the pupa might almost be described as having

a smooth surface, dotted with pits, many of these pits, especially dorsally on the 4th abdominal, having a crescentic flat ridge in front of them, very much after the sculpturing of the pupa of *Mimas tiliae*. The prespiracular ridges are also rather numerous and well-marked. The pupa of *Turneria hippophaës* again suggests that the larval colouring is of less value systematically than the horn. The pupa is very close to that of *H. euphorbiae*, varying perhaps a little in the direction of that of *T. vespertilio*.

Hybridity among the Eumorphids has been repeatedly recorded, but the data at disposal are weak and have little value scientifically compared with those already detailed (*antedà*, iii., pp. 391 *et seq.*) and relating to the Amorphids. The described forms are *Theretra* hybr. *standfussi*, *Hyles* hybr. *epilobii*, *H.* hybr. *pauli*, *H.* hybr. *eugeni*, *H.* hybr. *lippei*, *Turneria* hybr. *vespertilioides*, *Celerio* hybr. *phileuphorbia*. There is no absolute certainty, in fact, that a single reputed hybrid form here mentioned is a hybrid. The parentage is not certainly known nor has a single experiment by breeding *ab ovo* confirmed the possibility of hybridity in any Eumorphid species unless we accept absolutely the facts of Rossi (*Ins. Börse*, xix., p. 369). The evidence, however, has been carefully weighed, and the facts are here given. After detailing the reputed hybrids in this subfamily, Standfuss writes (*Handbuch*, p. 54): "All three forms—*standfussi*, *epilobii*, *vespertilioides*—have both been captured as imagines and also bred from larvæ taken at large; I am not aware that any of these hybrid pairings has been successfully carried out in captivity. Very remarkable Deilephilid larvæ have been found by Herr J. Röber (Dresden) on fuchsia, but, unfortunately, he did not succeed in breeding them. These larvæ appeared to have come from a crossing of *Hyles euphorbiae* and *Eumorpha elpenor*." Standfuss further notes (*Ent.*, xxxiii., p. 342) that the law that primary hybrids generally produce an individual which is relatively nearer to the phylogenetic older species than the newer, is strikingly exemplified by the hybrid *euphorbiae* ♂ × *vespertilio* ♀. He writes: "All the individuals of this crossing which I have yet seen—about 50 specimens—are so near to *D. euphorbiae* that one would suppose that they were an ill-characterised variation of the latter species if its hybrid extraction were not known *. The type of *D. euphorbiae* is distributed over nearly the whole world in numerous species, and is, therefore, almost certainly the relatively older; whereas *D. vespertilio* is a solitary type of eccentric character occurring over a very limited area, and, therefore, most probably newly formed." The following are the original descriptions (and later notes) of the forms referred to:

1. THERETRA hybr. STANDFUSSI † Bart., "Pal. Gross-Schmett.," ii., p. 122 (1900); Rossi, "Ins. Börse," xix., p. 369, fig. (1902). (?) *Elpenor × porcellus*, Hug., "Mitt. Schw. Ent. Ges.," iii., p. 510 (1872). *Elpenorellus*, Staud., "Cat.," 3rd ed., p. 104 (1901).—*Deilephila* corpore viridi, lateribus roseis, fascia media longitudinali nulla, thorace viridi, fasciis longitudinalibus roseis quatuor, antennis albis. Alis anterioribus olivaceis, margine exteriore fascia rubra, intus den-

* Standfuss does not inform us how the hybrid extraction of this form is known.

† Assumed parentage ♂ *porcellus* × ♀ *elpenor*. The larva was found on *Epilobium* where one would expect a ♀ *Eumorpha elpenor* and not a ♀ *Theretra porcellus* to lay its eggs.

ticulata, in medio duabus fasciis obscurioribus et puncto albo instructis, ciliis rubris unicoloribus. Alis posticis in margine ad angulum interiorem incisura magna instructis, denticulatis, ciliis maculatis, in costis roseis, radice usque ad medium fere nigris, dein olivaceis, fascia terminali obscuriore. Some weeks since I received an insect exactly intermediate between *D. elpenor* and *D. porcellus*. Exact comparison shows it to be a hybrid between the two species. The size is exactly intermediate between the average wing-expanse of *elpenor* and *porcellus* (*elpenor* 21mm.-23mm., *porcellus* 16mm.-18mm.), it amounts to exactly 20mm. The body, in form and colour, partakes exactly of the characters of the two. In *porcellus*, the colour of the body is usually red, mixed with green on the front of the thorax, the upperside of the head is usually green, the underside of the abdomen is slightly tinged with green; the collar is always red. In *elpenor*, the ground colour of the body is olive-green, a longitudinal band on the upperside of the abdomen, and its sides red. The green thorax bears the 4 well-known red longitudinal bands, collar and upperside of head are green. In addition, the form of the abdomen is different in the two species, that of *porcellus* undergoes a quick and sudden narrowing behind the middle, which is not the case in *elpenor*. The intermediate form has head and thorax of *elpenor*, and, therefore, lacks the red collar. The abdomen, too, is green as in *elpenor*, the sides red. The red longitudinal band is wanting. On the other hand, the form of the abdomen, especially its rapid narrowing towards the apex, is quite similar to the symmetrical proportions in *porcellus*. The antennæ are exactly those of *porcellus*; in *elpenor* they are always tinged with red on the hinder half, in *porcellus* white. Those of the intermediate form are white, and are also not so long as those of *elpenor*. The forewings share most precisely the characters of those of the parents. *Porcellus*, as is well-known, possesses the strongly sinuated outer- and inner-margin, which gives it its characteristic wing-form; *elpenor* has not this. The hybrid of which we are speaking has a weakly sinuate outer- and innermargin. The border in *elpenor* is purely red, in *porcellus*, at least in the outer part, chequered with white between the nervures. In the intermediate, there are none of these white spots. The broad red area on the outer margin corresponds in form with that of *porcellus*, the indentations on the inner margin thereof are especially very strong and distinct as in *porcellus*. Further, the red areas of *porcellus* are entirely wanting on the costal margin, on the other hand, the red stripe bordering the costal margin of *elpenor* is not wanting. The two oblique red bands of the latter are found in the intermediate form. They follow entirely the same course as in *elpenor*, but their red is extremely indistinct and pale, they are distinctly marked by the darker green border on the outside, which *elpenor* also possesses and which stands off distinctly from the ground colour of the wing. The red splash on the inner side of the inner oblique stripe is distinctly present, as also the white spot between the costa and inner oblique stripe. The upper wing thus approaches more in form and colour to *elpenor*, though with an unmistakable mingling of the characters of *porcellus*. In colour it inclines more to the yellowish-green of *porcellus*. The hindwings are in the highest degree characteristic. As is well known, *porcellus* approaches the genus *Smerinthus* in the cut of these. The sinuate hindmargin, the indentation at the inner angle, the strongly sinuate inner-margin, and the white- and red-spotted fringes, essentially distinguish it from *elpenor*, whose hindwings have none of these characters—the fringes in particular being unicolorous white throughout. Now, in the hybrid, the form of the hindwing is altogether that of *porcellus*, not wantiug the strongly sinuate outer- and inner-margin, whereby arises the characteristic "tooth." The fringes likewise agree most exactly in being red- and white-chequered. On the other hand the colour of the hindwings is more that of *elpenor*. The half of the wing is deep black as in that species (in *porcellus* the black area is small and narrow). Thereto follows a dirty reddish-green area, which in *elpenor* appears much more intensely coloured. A suggestion of *porcellus* appears again in a darker marginal area which corresponds entirely, in form and extent, with the red marginal-band of the hindwings of *porcellus*. There is some indication of the narrow dark stripe which, in *elpenor*, runs through the middle of the red area of the hindwings. Altogether the hindwings show such an exact blending of the peculiarities of those of the prototypes that on an exact consideration of them all doubt must vanish. It is to be added that, on the hindmargin of the forewings, towards the inside, *elpenor* has a tuft of black hairs which is margined externally by a white one that loses itself in the margin of the wing. This structure is wanting in *porcellus*. The

hybrid, in general, possesses it. The upperwings are more *porcellus*, with the exception of the black basal area (Huguenin).

The details of obtaining the moth are given by Gruet (of Renan) as follows: Larvæ found in July, 1870, on the large *Epilobium* in the ditches on the banks of the Suze; they were of different sizes, with the colours more or less dark, and I supposed they were of the same species, but, in the spring of 1871, on the emergence of this particular specimen, my father sent it to you. *Porcellus* is also found here, but I have not yet been able to discover the larva. Bartel gives (*Pal. Gross-Schmett.*, ii., pp. 122—123) another detailed description of the specimen, and adds: "There is a further specimen of this interesting hybrid in Wiskott's coll., Breslau." Rossi notes (*Ins. Börse*, xix., p. 369) that Jörgens, in 1890, fed up larvæ of *porcellus* and *elpenor* on a patch of *Galium* in his garden, covering them with a basket and allowing them to pupate on the spot. In May or June, 1891, he found under the basket a ♂ *porcellus*, *in cop.* with a ♀ *elpenor*. He allowed the ♀ to oviposit under the basket, and in August had three halfgrown larvæ, of which only one pupated, and produced a fine hybrid imago in January, 1892, which was sold to Heyne, and a figure of which is reproduced (*loc. cit.*). He describes the imago as having the wings and the form of the body nearer *elpenor* than *porcellus*. In size it is intermediate—57mm., as against 68mm. for Rossi's largest *elpenor*, and 48mm. for his largest *porcellus*. Body coloured much as in *elpenor*, thorax olive-green with rose-red stripes, abdomen green in middle, red at side and tip; the median red stripe which divides the green central area of abdomen in *elpenor* is hardly visible. The forewings are olive-greenish, the inner oblique violet-red stripe of *elpenor* is more yellow-reddish, towards the margin there are three additional darker green oblique stripes. The white longitudinal stripe which *elpenor* has at base of inner margin is present, but seems to be more reddish-white. The costa is narrowly margined with rose-red, the outer margin broadly with the same colour, while in *elpenor* it is violet-red. The hindwings resemble those of *porcellus*; they are black at the base, yellowish in the middle, rose-red at the border, the black at the base is, however, darker than in *porcellus*.

2. HYLES hybr. EPILOBII*, Bdv., Rbr. and Gras., "Icon. Chen. Sphing.," pl. ix., fig. 2 (1832); Bdv., "Icon.," ii., p. 24, pl. 51, fig. 3 (1834); "Spec. Gen.," i., p. 177 (1875); Dup. "Hist. Nat.," supp. ii., p. 123, pl. xii., fig. 1 (1835); H.-Sch., "Sys. Bearb.," ii., p. 89, fig. 9 (1846); Staud., "Cat.," 2nd ed., p. 36 (1871); 3rd ed., p. 101 (1901); Hofm., "Gross-Schmett.," &c, p. 29, pl. xvii., fig. 1 *b* (1884); "Raupen," &c., p. 285, pl. xlviii., fig. 11 (1893); Kirby, "Cat. Het.," p. 668 (1892); Stdfss., "Handbuch," &c., pp. 54, 63 (1896); "Exp. Zool. Stud.," p. 43 (1898): Schlumb., "Mitt. Mühl. Ent. Ver.," no. 12, pp. 1–6 (1897); no. 13, pp. 2—4 (1898); Bart., "Pal. Gross-Schmett.," ii., p. 63 (1899); Mory, "Mitt. Schw. Ent. Ges.," x., p. 33, figs. 2—3 (1901).—IMAGO: Alis anticis subcinereis fascia obliqua extus angulosa ad apicem, alteri basali, macula media obsoleta thoraceque, cinereo-olivaceis; posticis rubroincarnatis basi limboque nigris, angulo anali albido; omnibus subtus roseis extimo cinereo, anticis macula media, obliqua nigra (*Icones*, ii., p. 24, pl. li., fig. 3). LARVA: Nigra flavo lateraliter punctulata, maculis seriatis, rotundatis, flavis; fascia laterali interrupta vel subnulla rubra; capite cornuque minuto, nigris. The great rarity of this larva, its colour and its markings, prove

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* Assumed parentage ♂ *euphorbiae* × ♀ *vespertilio*. The larvæ were taken on *Epilobium*, the food of the last-named species.

clearly that it is only a hybrid of *vespertilio* and *euphorbiae*. It is of the form of *euphorbiae*, and has the same black colour, but the little yellowish spots have a tendency to disappear, and are not visible at all above. The first three segments bear the rudiments of a red dorsal line. The sides, near the legs, are marked with an interrupted red line. The belly has also traces of reddish. The stigmata are ovoid, of a yellowish-white, with the border black. The horn is small and black. The head is black, with a part of the sutures red. The legs are blackish on their outer side, red on the inner. It lives on *Epilobium angustifolium*, near Lyons, whence it was sent by M. Merk, a naturalist of that town (*Chenilles Sphing.*, pl. ix., fig. 2).

Boisduval suggests this only as a probable hybrid; he states that the larva presents no special characters. The forewings and thorax of the imago, however, are nearly as in *Hyles euphorbiae*, the hindwings and abdomen nearly as in *Thaumas vespertilio*. He states that the moth is very near *Turneria* hybr. *vespertilioides*, the thorax "olive" instead of "ashy-grey," the bands of wings darker, more pronounced, and that, towards the extremity, they are more angulated and blend less completely with the tint of the ground-colour; the rose-colour of the hindwing also occupies less space, &c. Standfuss states, as we have noted, that, of some 50 examples of the hybrid that he had seen, all were so near *Hyles euphorbiae* that one would suppose that they were an ill-characterised variation of the latter species if its hybrid extraction were not known*. His further observations have also already been referred to (*anteà*, p. 44). Bartel says (*Pal. Gross-Schmett.*, ii., pp. 64—65) that the imago has more similarity to *H. euphorbiae* than to *T. vespertilio*. The forewings, however, are much darker grey than in the former species, and of a very dusky hue; the costa, the costal spots, and the oblique band which, as in *H. euphorbiae*, runs into the outer area, are dark olive-green or olive-brown; the costal spots, however, are irregular, weakly developed, and scarcely perceptible. The inner side of the oblique band is slightly curved, whilst the space between this band and the inner margin is coloured dark blue-grey as in *T. vespertilio;* the part of the band that is always pale in *H. euphorbiae* is slightly tinged with red, and darkened by numerous flake-like dots, although, rarely, it appears somewhat lighter. At the base there is an olive-brown spot, margined on either side with light grey hairs, similar to those of *T. vespertilio*, the corresponding hairs in *H. euphorbiae* being always pure white. The form and markings agree with those of *H. euphorbiae*, the nervures are prominent, but, as in *T. vespertilio*, are more rose-coloured, whilst the black marginal band is similar to that of the latter species, but is much further removed from the margin than in this species. The black basal area extends as in *H. euphorbiae*, and runs into a white spot very faintly tinged with rose-colour at the inner angle; in *T. vespertilio* this is always reddish, and differs little from the rose-colour of the wing. Between the border and its black marginal band the colour is pale ash-grey or brownish. The underside pale rose-red, with basal half of forewings blackish, whilst towards the centre of the latter is a sharply-defined colour which rarely fades gradually into the ground-colour; this area is very weakly indicated in *T. vespertilio*, strongly marked in *H. euphorbiae*. The outer margin, as in both these species, is occupied with a blackish

* We have always been, and still are, under the impression that the actual parentage of these examples is not known.

or reddish-violet band. Hindwings with lighter central area sometimes banded, as in *H. euphorbiae*, with black transverse stripes; the marginal band and basal area darker; the transverse stripes sometimes less distinct than in the latter species. The antennæ, white above and brownish beneath, exhibit no special feature. The head and thorax are olive-green above, the latter rarely grey-haired as in *T. vespertilio*, but always margined laterally with white. Abdomen ashy-grey mixed with olive, with two alternately black and white lateral spots and only insignificant differential characters; the white front margins are wanting from abdominal segment 5 onwards. The underside of abdomen and thorax are rose-red. The legs show no special peculiarity. From *T.* hybr. *vespertilioides*, *H.* hybr. *epilobii* is distinguished by its olive-green thorax, which is ashy-grey in the former, and by the darker and sharper bands of the forewings. The band along the outer margin of *H.* hybr. *epilobii* is, moreover, more angular and passes less gradually into the colour of the outer margin. The red of the forewings is also more restricted, and the underside of the forewings shows an oval black spot as in *H. euphorbiae* and *H. dahlii*. The larva is most like that of *H. euphorbiae*, and agrees with it also in form and mode of life. When full-grown it is black, covered on the back and sides with innumerable small yellowish or yellow-reddish spots or points. These spots are inclined to disappear, yet specimens without them but rarely occur. The larva of *H.* hybr. *epilobii* has, like that of *H. euphorbiae*, a red, sometimes reddish-yellow, stripe, which runs along the middle of the back, and is sometimes represented only by faint remnants on the 3rd and 4th segments. On the sides of the dorsal area are, on each segment, two whitish- or yellowish-red oval or round spots standing one above the other; they are margined with black, and the lower of them is always much smaller than the upper. Beneath these spots there is sometimes a further row of very small dots. Above the legs runs a stripe composed of red spots, but this likewise has a tendency to disappear. The yellowish-red or yellow-brown venter also exhibits, medially, some rather dark red or reddish stripes. The spiracles are oval, pure white or yellowish-white, with black margins. The horn on the 11th segment is very small, and coloured red in its lower third; its two upper thirds are black. Head, anal prolegs ("Nachschieber"), and anal-flap likewise red, the former sometimes with red sutures. The legs are also of a reddish colour, exteriorly overlaid with black. Larvæ also occur, which are distinguished by an unicolorous black head and unicolorous black horn, and in which the dorsal line is very narrow and often only reaches to the 3rd segment, and in which, further, only the thoracic legs are black-coloured at the tip; but, in other respects, these specimens agree with the others. The larva of this hybrid differs from that of *H. euphorbiae* (with which, but for its occurrence on *Epilobium*, it might easily be confused) in having its horn less strong and scarcely half as long as in the latter species. The larva is found at large from July to September on *Epilobium angustifolium*, *E. dodonaei* and *E. fleischeri*, as well as on other species of *Epilobium*. It is full-grown at the beginning of September, and rests partly at the foot and partly on the stem of

the foodplant. In this, it differs considerably from the larva of *T. vespertilio*, which, by day, is to be found under stones or on the earth. The pupa, in form and colour, more resembles that of *T. vespertilio* than that of *H. euphorbiae*. It is yellow-brown; dorsal area and abdominal segments above darker, with small blackish spots or streaks. The wing-cases are greenish as in the pupa of *T. vespertilio* (in the empty pupa-case yellowish-brown) while in *H. euphorbiae* they are grey-yellow. The pupa of *H.* hybr. *epilobii* is more slender than that of *H. euphorbiae*, the cremaster is somewhat longer, its forked points somewhat shorter than in either of the original species. Like them, the pupa of *H.* hybr. *epilobii* sometimes goes over a second winter." As to the parentage, Bartel says that *H.* hybr. *epilobii* originates probably, according to Boisduval, from ♂ *euphorbiae* × ♀ *vespertilio*, since the larvæ found on *Epilobium* rejected the spurge that was offered them. It is well known that the various species of *Tithymalus (Euphorbia)* form the foodplant of the larva of *H. euphorbiae*, while that of *T. vespertilio* only occurs on *Epilobium*, and one may easily assume that the eggs of *T. vespertilio*, as also those of *H.* hybr. *epilobii*, are laid on or near *Epilobium*, whereas if the ♀ [parent] of this hybrid were *H. euphorbiae*, then it would instinctively have laid its eggs on spurge, the foodplant of that species, but no larvæ of *H.* hybr. *epilobii* have hitherto been found on *Tithymalus (Euphorbia)*. Although this hybrid might occur everywhere where the range of distribution of *T. vespertilio* coincides with that of *H. euphorbiae*, yet only a few localities for it in a small part of the central and southern part of Western Europe have been made known. This speaks distinctly enough for its extraordinary rarity, as also, in general, for the sparing occurrence of hybrids in a state of nature. In the literature which has been searched, only the following localities have been found catalogued: Alsace—Hüningen, in July; Switzerland—Basle, Valais Alps; Tyrol—Bozen; Lower Austria—Vienna; Southern France—neighbourhood of Lyons.

3. TURNERIA hybr. VESPERTILIOIDES *, Bdv., "Ann. Soc. Lin. Paris," 1827, p. 114, pl. vi., fig. 4 (1827); "Icon. Chen. d'Europe, Sphinges," pl. ix., fig. 1 (1832); "Icones," ii., p. 22, pl. xlix., fig. 3 (1834); "Spec. Gén.," i., p. 175 (1875); Dup., "Hist. Nat.," supp. ii., p. 125, pl., xi., fig. 2 (1835); H.-Sch., "Sys. Bearb.," ii., p. 89, figs. 10, 13 (1846); Staud., "Cat.," 2nd ed, p. 36 (1871); 3rd ed., p. 101 (1901); Stdfss., "Handbuch," &c., pp. 54, 63 (1896); Bart., "Pal. Gross-Schmett.," ii., p. 61 (1899); Mory, "Mitt. Schw. Ent. Ges.," x., p. 339 (1901).—IMAGO: *Sphinx hippophaes* affinis, alis anticis cinereis; facia [sic] lata sinuataque, cinereo-plumbea nitente, paululumque dilutiori ad marginem; macula baseos alba nigro variegata; punto [sic] lunulaque nigrofuscis obsoletis supra disco, alis posticis rubro-incarnatis basi et limbo nigris; angulo anali dilutiori, antennis albis; corpore cinereo duobus fasciolis albis totidemque nigris cingulato. LARVA, absque cornu nec tuberculo, lævis oeneo [sic] viridis duobus lineis pallidis lateralibus a capite ad ultimum segmentum; corpore punctis multis adsperso, stigmatibus aurantiacis nigro cinctis; maculis duobus carneis ellipticis in anali segmento; capite cinereo ventro pedibusque carneis, quorum ad basin lineola rubella. The larva of this species much resembles those of *hippophaes* and *vespertilio*. Its body is bronze-green, dotted with whitish; each side is traversed by a greenish-white line along its whole length. There is no trace of horn or wart on the last segment; the stigmata are orange, surrounded by a black aureole, above that of the last segment one notices an oblong spot of a fleshy-red and some blackish transverse lines. Immediately above the base

* Assumed parentage, ♂ *hippophaes* × ♀ *vespertilio*.

of the legs there is a pale rose-coloured line. The entire belly is of a delicate rose-colour; the legs are bright red, as is also the crown of the prolegs. I found this larva on July 22nd, 1825, on the subalpine mountains of the Dept. of Isère on the banks of the Drac. It was almost fullgrown and pupated some days later. I brought the pupa to Paris, and, on July 18th, 1826, after a year, all but 4 days, there emerged a very fine Sphingid, which, in colour and markings, appeared to be a hybrid between *hippophaes* and *vespertilio*, if only viewed casually, but, as it has yet to be proved that such crossings occur in the wild state, I prefer to regard it as a legitimate species, especially as two of my acquaintances have obtained the same insect from exactly similar larvæ taken in the same locality (Boisduval, *Ann. Soc. Linn. Paris*, 1827, pp. 114 *et seq.*).

Boisduval re-described this form later (*Icones*, ii., p. 22) as "Alis anticis cinereis, fascia obliqua ad apicem, altera basali, punctoque medio obscurioribus; thorace cinereo, posticis rubro-incarnatis, basi limboque nigris; omnibus subtus pallido-roseis, atomis sparsis margine basique cinereis. Ce Sphingide étant très-rare, et ne presentant point de caractères propres, mais un mêlange de ceux que nous offrant *vespertilio* et *hippophaes*, nous croyons devoir de considerer comme un hybride produit par l'accouplement de ces deux espèces. . . . . Nous l'avons trouvé en bord du Drac, au rocher de Sessin, près de Grenoble, localité où *vespertilio* et *hippophaes* sont fort commun. Voyez pour la figure et la description de la chenille, notre *Icon. des Chen. d'Europe*, pl. ix., fig. 1." Boisduval notes that the forewings have similar markings to *Turneria hippophaes*, but the tint a little more ashy; the hindwings on the contrary being almost exactly like those of *Thaumas vespertilio*. Bartel says (*Pal. Gross-Schmett.*, ii., p. 61): The peculiar larva of *vespertilioides* exhibits, in colour and markings, a mixture of the characters of the larvæ of *Thaumas vespertilio* and *Turneria hippophaes*, but it is darker than the latter, bronze-green, only occasionally duller green, the tint a mixture of those of the larvæ of the parent species. The front part of the body of the larva is rather less stout than in that of *T. vespertilio*, and, like the rest of the body, is furnished with white dots which, however, are not nearly so numerous, though much larger, and only become weaker on the upper anterior part of the segments; two greenish-white, scarcely conspicuous, lateral lines run from the head to the last segment, and carry, on each side, as in larva of *T. vespertilio*, a row of reddish but smaller dot-like spots, their colour in the anterior portion connecting them with the lines; in these darker ringed spots the white dots are wanting. The very small caudal horn sometimes almost obsolete. The two spots at its sides are placed as in the larva of *T. hippophaes*, usually rather long, bright flesh-colour and bordered by a few black striæ. A white longitudinal line runs along each side of the body. The spiracles are orange-centred, ringed as in the larva of *T. vespertilio* with black, whilst under these runs a pale rose-red stripe above the legs, which is made up of separate reddish spotlets, of which only one lies on each segment. Head dull green tinged with weak reddish-grey; mouthparts brown; venter and upper part of claspers reddish, the undersides of latter and true legs deep red. Some larvæ, approaching more closely those of *T. hippophaes* in the length of the caudal horn, are found in July and August on *Epilobium angustifolium* and *E. dodonaei*, whilst those which most approach the larvæ of *T. hippophaes* feed on *Hippophae rhamnoides*. The larvæ were taken with those of the parent species. The

pupa is similar to that of *T. hippophaes*, goes over the winter, the imagines appearing at the same time as those of *T. vespertilio* and *T. hippophaes*, although an occasional specimen may emerge in September, the pupa not going over the winter. Boisduval considered the ♂ parent to be *T. vespertilio*, the ♀ *T. hippophaes*, but Bartel suggests that as the supposed hybrid larvæ were feeding on the foodplants of both parent species, the reverse cross may also have taken place. He further notes that the hybrid *vespertilioides* is separated from *T. vespertilio* by the black instead of white spot on the cross-vein of the forewings, the diagonal band, and the pale edges of the thorax. The ash-grey ground-colour of the body and forewings, the darkened portion before the diagonal band on the latter and the reddish spot at the anal angle of the hindwings, separate at once the hybrid from *T. hippophaes* and the other Deilephilid (*i.e.*, Phryxid) species.

4. HYLES hybr. EUGENI *, Mory, "Mitt. Schw. Ent. Ges.," x., p. 341, figs. 4, 5, 6 (1901).—IMAGO : Scales on forehead and crown dark grey to black-grey, a white lateral stripe; palpi white, terminal joint dark grey with a white stripe above. Antennæ white, with reddish-brown pectinations. Thorax above, bright to dark grey, below, bright to dark grey or rose; patagia whitish on the outer portion, white towards the head. Abdomen above, dull-grey with a strong or weak dark olive-green tint; two black lateral spots on segments 1 and 2 behind each white patch; some examples have white ring-like marks on the abdomen; beneath, the abdomen, like the thorax, is variously coloured. Forewings, with the ground-colour bright grey; the border of the oblique band darker grey, the latter in form like that of *H.* hybr. *epilobii*; outer marginal band darker grey, narrow, in clear contrast with the ground-colour; the spot on inner margin dark grey, coalescent with the black basal spot, both forming together a large blackish basal spot; a patch of white hair beside this spot on inner margin and also above it at base of wing; the third dorsal spot absent (one example, fig. 4, with the forewings entirely dark grey). Hindwings with the ground-colour as in *T. vespertilio* or slightly darker red, basal spot spreading more or less towards disc of wing; the spot on the anal angle very pale, almost white; marginal band at a great distance from the fringes (in one example, in coll. Standfuss, quite as far as in *H.* hybr. *epilobii*); the space between fringes and marginal band with grey or rose-coloured scales. Fringes of forewings on outer margin dark greyish-brown, paler on inner margin; of hindwings white. Underside of wings with a bright to dark reddish ground-colour; lateral margins of disc grey; base of forewing grey, the dark grey spot on the transverse nervure visible corresponding with the second dorsal spot of upperside. LARVA: [15 larvæ taken with 200 typical larvæ of *T. vespertilio* are assumed to be hybrid on the following characters: Caudal horn short; variable in colour and markings, especially after last ecdysis.] The fifteen larvæ were then diagnosed as: (1) Ground colour bronzy-green; caudal horn present. (2) Ground colour black; caudal horn present. (3-4) Ground colour bright bronze, reddish spots behind the yellow oblong lateral spots, the venter and prolegs red (more intense than in *vespertilio*); caudal horn present. (5-7) Mediodorsal reddish stripe from head to anal flap; lateral spots and prolegs reddish, venter red, without caudal horn. (8) Ground colour black; oblong spots rosy; reddish dorsal stripe and prolegs, above the latter a row of white spots; small caudal horn. (9-10) Venter and dorsal stripe red; oblong spots ringed with black on the anterior half of larva, with red on the posterior half; caudal horn present. (11) Like *vespertilio*, but with caudal horn. (12) Colour of the oblong spots reddish, venter and prolegs red; without caudal horn although a distinct hump is present. (13) Colour black, small caudal horn. (14-15) Not different from *vespertilio* larva.

Mory's facts may be summarised as follows: 15 young larvæ taken among 200 typical larvæ of *Thaumas vespertilio*, in early June,

* Assumed parentage, ♂ *epilobii* × ♀ *vespertilio*. Until this is proved by crossing and breeding, most of Mory's speculations must be considered as very doubtful.

1900, at Hüningen, in Upper Alsace, on *Epilobium rosmarinifolium*, differed from the typical form in coloration and markings, and, in some cases, by having a caudal horn, in others a short horn; they became very variable at the last ecdysis, and no two of the fifteen were exactly alike; part, however, are said to have been not very unlike the larva of *H.* hybr. *epilobii* (no details are given as to how the comparison with this larva was made), another section was hardly separable from *T. vespertilio*, the remainder about midway between both forms. The markings of *H.* hybr. *eugeni* are very similar to those of *H.* hybr. *epilobii*, but the coloration is very similar to that of *T. vespertilio*. Lippe, in the same locality, on the same foodplant, but at a later date, collected 18 almost fullfed larvæ, probably of the same brood, and bred similar imagines, and some of his imagines are figured by Mory. Mory asserts that the examples cannot be aberrations of *T. vespertilio*, because the larvæ possess striking hybrid characters, *i.e.*, either the characteristic caudal horn or a coloration reminding one of the larvæ of *H.* hybr. *epilobii*. The rest of Mory's long argument is full of assumptions, and, as the whole of his facts are summarised above and his figures are available, lepidopterists can draw their own conclusions. We own to more than a doubt as to the hybrid origin of the moths.

5. HYLES hybr. LIPPEI *, Mory, "Mitt. Schw. Ent. Ges.," x., p. 344, figs. 7-9 (1901). — Three of the larvæ included in the description of those of *eugeni* (*suprà*) produced imagines in August, 1900, which I here name *lippei*. Which of the larvæ produced the moths is unknown. Lippe also bred a specimen like these. Three imagines are figured (figs. 7, 8 and 9), one (fig. 8) came from Lippe, the others bred by myself. The moths are not very dissimilar from those of *T. vespertilio*. The oblique band of forewings is entirely absent. The spots on the dorsal margin are only represented by a weak indication of the second spot on the transverse nervure, which is about as distinct as in *T. vespertilio*. The basal spot is not larger than in *T. vespertilio*, the white tufts are, however, connected with it as in *H.* hybr. *eugeni*. The disc of the wing and the space usually occupied by the oblique band (except the borders) vary in the scaling from pale to strongly red. Lippe's example (fig. 8) is so intensely red-scaled that the grey bordering, in the form of a line, is clearly in contrast with the rest of the wing. This difference in the red-scaling of the three examples may probably be referred simply to individual variability. Fringes as in *H.* hybr. *eugeni*. The hindwings are not essentially different from those of *H.* hybr. *eugeni*, though the pale spot at the anal angle is more strongly tinted with reddish, but in each case paler than in *T. vespertilio*. In one ♀, the basal spot and marginal band (which is as in *H.* hybr. *eugeni*, clearly at a distance from the margin) are in connection with each other. The body of *H.* hybr. *lippei* is lighter than that of *H.* hybr. *eugeni*, in fact, only a little darker than in *T. vespertilio*. No essential differences in the underside between *H.* hybr. *lippei* and *H.* hybr. *eugeni*. The differences between *H.* hybr. *lippei* and *T. vespertilio* rest rather on the different physiognomy of the forms than on detailed and special characters, although such are not wanting, *e.g.*, *H.* hybr. *lippei* may be separated from *T. vespertilio* by the greater distance between the marginal band of hindwings and fringes, by the light spot at the anal angle of hindwings, by the much darker ground-colour of the forewings, by the more or less strongly red scaling exhibited by the distinctly paler lateral and median border of the basal spot of the forewings, and, lastly, by the dazzling white streaks on the side of the head, on the upper part of the terminal joint of the palpi, and at the base of the palpi. In *T. vespertilio* these parts are pale grey not clear white.

The whole of Mory's facts are quoted above. From them he concludes that *H.* hybr. *lippei* represents a hybrid of the third degree with parentage ♂ *eugeni* × ♀ *vespertilio*. There is, in our opinion, grave

* Assumed parentage, ♂ *eugeni* × ♀ *vespertilio*.

doubts as to whether it is anything but a form of *Thaumas vespertilio*. His argument appears to support us in this conclusion.

6. HYLES hybr. PAULI *, Mory, "Mitt. Schw. Ent. Gesell.," x., p. 350, fig. 1 (1901). — Head dark olive-green above, white towards the sides; palpi grey, terminal joint below dark grey, above olive-green; antennæ white above, pectinations red-brown. Thorax dark olive-green above; white towards the sides, the inner edges of basal half of patagia white; reddish-grey beneath. Abdomen above dark olive-green; the 1st and 2nd abdominal segments each bear laterally a black spot with white scales behind each spot; brown-grey beneath, the centre grey with scattered black hair-scales, the 1st abdominal, however, whitish, without black hair-scales. Wings pointed, but not so acutely as those of *T. hippophaes*; the disc whitish-grey, the margins grey, the costa olive-green, blended with the three somewhat darker dorsal † spots; oblique band darker olive-green, broad on inner margin, towards apex much waved, the costal border indistinctly dentate; at the base a black spot bordered at sides with white scaling, reaching the inner margin at its base and touching the first costal spot at its apex. Most of the nervures are white where they pass through the oblique band. Fringes on outer margin dark brown, on inner margin white. The upperside of the hindwings is of a salmon-pink ground-colour, just as in *T. hippophaes*, the basal black spot extends towards the middle of the wing and joins, at the outer angle, the very broad marginal band; anal angle white; fringes white. The underside of wings are very similar to those of *Hyles tithymali*, both in colour and markings as well as the sprinkling of black scales. The upperside (especially of the forewings) also bears a certain resemblance to *H. tithymali*.

The moth from which this description was made was bred from a pupa obtained from a larva taken in 1897, near Sion, in the Valais, by Paul, on *Hippophae rhamnoides*. No description of the larva was made, but, on the superficial appearance of the imago, and without any further evidence, Mory concludes that the parentage of the moth is ♂ *euphorbiae* × ♀ *hippophaes*.

7. CELERIO hybr. PHILEUPHORBIA ‡, Mütz., "Wiegm. Arch.," viii., pp. 171-4, pl. viii., fig. 1 (1840); Kirby, "Cat.," p. 665 (1892); Bart., "Pal. Gross-Schmett.," ii., p. 75 (1899); Staud., "Cat.," 3rd ed., p. 102 (1901).—? *Gallii*, Staud., "Cat.," ii., p. 36 (1871).—Alis anticis virescentibus, vitta pallida pellucente; posticis nigris fascia rubella rubromaculata; thorace nigro terminato ciliis, albis, antennis viridi-fuscis apice albis; parte aversa pene subrubricunda. Larva caudata virescens punctis pallidis utrinque decem ocellaribus capite cornuque rubro, linea dorsali lutea. Pupa brunnea stigmatibus nigris et fuscis. The *larva* § is, in its penultimate instar, light green, with an ill-developed yellow spot on each segment on either side of the darker dorsal stripe. The horn is light red, black at the tip. The length of the largest larva almost 100mm. In the last instar, the ground-colour is light olive-green, flesh-colour, or reddish ventrally; on either side is a fine yellow-green dorsal stripe, and not far from this stand ten — on the anterior segments quite small, on the posterior larger—yellow spots on a black ground, and, for the most part, having a brick-red tinge in the middle; on each segment there is a blackish spot towards the venter; on the sides, as far as to the yellow spots, and also between the same, the larva is covered with fine red-yellow dots, which sometimes appear only sparingly, and are then usually lighter; the head and caudal horn are red; the former about the mouth black, whilst behind it stands a red prothoracic shield; the legs, prolegs, and anal claspers black, spotted with red. The *pupa*, of which the wing-cases are darker than the rest of the body, is coffee-brown with blackish dashes and dots; the spiracles black. None which I have seen have exceeded the

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* Assumed parentage, ♂ *euphorbiae* × ♀ *hippophaes*.

† Should not this be "costal"? (Sich).

‡ Assumed parentage ♂ *gallii* × ♀ *euphorbiae*.

§ Fuessly (*N. Mag.*, ii., pt. 1, p. 70) and Ochsenheimer (*Die Schmett.*, ii., p. 220) have described the same larva but the examples died before changing.

measurements of a medium-sized *D. euphorbiae*. The upperside of the *imago** is similar to that of *D. euphorbiae*, but the ground-colour of the forewings is more grey-green; between the spots at the base and that in the middle on the costa stands yet a third small spot, so that a distinct band is formed in the middle of the wing, which is pale yellow in colour, green-grey below and at the tip. The thorax is black-margined before the white hairs. The underside is more like that of *D. gallii*, but less distinctly defined, all the colours lighter in tone and mixed with a dirty flesh-colour, and the yellowish band on the forewings shows through less. *D. phileuphorbia* differs at first glance from *D. gallii* on the upperside through the lack of the white spots along the middle of the abdomen, and from *D. euphorbiae* through the grey-green antennæ, which are always white in the latter species. Three larvæ were found near Berlin in August, 1838, on *Euphorbia cyparissias*, resembling *D. gallii*, but no description was made of them; 2 ♂ moths emerged in June, 1839, which were evidently neither *D. gallii* nor *D. euphorbiae*, but either a new species or a hybrid, but, as hybrids are usually sterile, the recurrence of similar larvæ in larger numbers in September, 1839, induced the writer to consider it as a new species [Mützell, *Arch. Nat.*, vi., 1, pp. 171-4, pl. viii., fig. 1 (1840)]. [The name *phileuphorbia* is erected on p. 172.]

Bartel writes (*Pal. Gross-Schmett.*, ii., p. 76): "The hybr. *phileuphorbia*, Mütz., originates from a crossing of *gallii* and *euphorbiae*, most probably a ♂ of the former with a ♀ of the latter." The larva, he says, has quite the appearance of that of *gallii*, and he then quotes Mützell's description verbatim. Finally he summarises the differences by stating that *C.* hybr. *phileuphorbia* differs from *C. gallii* in the entire lack of the abdominal row of white spots, in the more unicolorous red of the hindwings, and in the dark grey dusted ground-colour of the lower part of the forewings. The antennæ, whose upper sides are only white at the tip, and the form of the oblique band of the forewings, sufficiently separate this hybrid from *H. euphorbiae*. As already indicated above, only bred near Berlin, from larvæ taken at large.

* The imagines, a typical example of which is in the collection of the Museum für Naturkunde, at Berlin, approach far more nearly *D. euphorbiae* in their forewings than *D. gallii*. The dark olive-green oblique band agrees in form with the latter species, but projects outwards in a serrated form. The costa, which is of a lighter olive-green than in *D. gallii*, is broadest at the base, and appears in the middle in a large spot, which projects into the pale yellow ground-colour. Before it stands a small, indistinct spot in the ground-colour. This is grey in the upper part of the wings, in the under part mixed with whitish and dark sprinkled, which never seems to occur in *D. gallii*, but very often in *D. euphorbiae*. Glossy light grey colouring extends before the outer margin of the forewings. Fringes light grey, in places lighter. The markings and colour of the hindwings likewise agree far more with those of *D. euphorbiae*. The black colour at the base occupies a smaller area than in *D. gallii*, and the band of the same colour before the border is narrow and much serrated. The red colour enclosed by the two is not whitish or yellowish in its upper part, as in *D. gallii*, but is here only a little lighter than in *D. euphorbiae*. Colour behind the black transverse band reddish, much more extended than in *D. gallii*. Fringes whitish, especially on the inner margin. Spot before the anal angle white. Underside similar to that of *D. gallii*. In the middle of the forewings stands a black spot near the costa, and the yellowish ground-colour is more extended; the colour before the outer margin, as also that of the hindwings, is mixed with reddish. The latter bear traces of dark transverse bands, but these are far more indistinct than in *D. gallii*. In general all the shades of colour are lighter and the markings more weakly expressed. Ground-colour of the body dark olive-green. Palpi white, olive-coloured at the tip; the latter above with a fine white line. Antennæ above somewhat lighter olive-green than in *D. gallii*, only at the tip white. Head and thorax white-margined. On the sides of the abdomen stand two alternately black and white spots, and the incisions of the four terminal segments are here, likewise, white-margined. It is striking that the dorsal line of spots on the abdomen, which is always present in *D. gallii*, is entirely wanting. Underside of body dirty yellow-brown; abdomen with white rings in the incisions (Bartel, *Pal. Gross-Schmett.*, ii., pp. 76—77).

This concludes the information we have been able to collect relating to hybidity among the Eumorphids. A few words relating to the distribution of the Eumorphids alone has to be added to this section. The powerful flight of the Sphingids is one of the most important factors in their distribution. Humboldt says that he saw Sphingids flying in the Andes 19800ft. above the sea. The South African species, *Daphnis capensis*, was taken 472 miles from land, the nearest point being Gibraltar, quite out of the normal range of the species (*Proc. Sth. Lond. Ent. Soc.*, 1891, p. 137). Fletcher found two *Phryxus livornica* on board ship one morning, in the Mediterranean, when about 100 miles from Greece, and when all the lights had been out the whole of the previous evening for manœuvring purposes (*Ent.*, xxxiv., p. 233). Manger has examples of *P. livornica* and *Hippotion celerio*, taken by Captain Walker, on board ship, in the Red Sea. *Manduca atropos*, *Daphnis nerii*, and other species have been seen and captured far out at sea. Many other similar cases are recorded in our accounts of the various species. It would appear, from the circumstantial evidence at disposal, that many Sphingid (and other) species that abound in the warmer temperate and subtropical regions are continually attempting to spread their range into the cooler temperate regions, and are ruthlessly exterminated by climate and other causes. Some of the immigrants reach our latitudes, and we thus have, in Britain, two groups of Eumorphid species with very different habits, *viz.* (1) Sedentary species—*Eumorpha elpenor*, *Theretra porcellus*. (2) Immigrants—*Hippotion celerio*, *Phryxus livornica*, *Celerio gallii*, *Daphnis nerii*, and probably *Hyles euphorbiae*. The present range of the last-named species on the western and north-western coasts of France, coupled with its reported occurrence abundantly in Devon some 80—90 years ago, and more recently in Cornwall, leaves us in doubt whether other than climatic causes have not combined to eliminate this insect as a sedentary species from our islands. At any rate, we offer, under the detailed account of this insect, sufficient evidence to show that it is now an occasional immigrant in districts where it could not very well ever have been sedentary. An interesting article, dealing with the questions of the immigration of *Daphnis nerii*, *Hippotion celerio*, *Agrius convolvuli* and *Manduca atropos*, much too long even to condense here, and in which the author takes a view somewhat opposed to ours, was published by Gaschet (*Ann. de la Soc. Entom. de France*, ser. 5, vol. vi., pp. 509—521). Meyrick notes (*Handbook*, &c., p. 294) the subfamily as large and nearly cosmopolitan, but dwelling especially in warm regions, the imagines flying at dusk and feeding on the wing, whilst he adds that most of the species occurring in Britain are probably only occasional immigrants, which, under favourable circumstances, breed here and establish themselves for a year or two. Bartel observes (*Palaeark. Gross-Schmett.*, ii., p. 54) that the *Deilephila* group (Phryxids) is relatively poorer in species than the *Choerocampa*-group (Eumorphids *sens. strict.*). Their representatives occur both in the eastern and western hemispheres. In Europe, the species of the first group are proportionally very well represented. The numerous species of the *Choerocampa*-group are distributed over the whole world, but especially in the tropics. The extremely powerful untiring flight, which is peculiar to most species of this group,

enables them, as we have already noted, often to travel great distances from their home into our own regions as immigrants. Bartel further points out that the Palæarctic Phryxid species belong for the most part to the southern and eastern portions of the region, and that some species, such as *Phryxus livornica*, *Hippotion celerio* and *Daphnis nerii*, of which the two last-named probably originated in the Ethiopian region, are only seen in the more temperate parts of the district in very warm and favourable seasons as immigrants. In such years they spread a considerable distance north, lay their eggs, the autumnal larvæ and pupæ being killed off under the more stringent climatic conditions to which they are subjected, and the species are not then seen again for some time. Some of our European species, *Daphnis nerii*, *Phryxus livornica*, *Hippotion celerio*, *Isoples alecto*, *I. boisduvalii* occur also in the Indo-Australian region, the three first-named and *Thaumas mauretanica* also in Africa. *Celerio gallii* is also recorded from Labrador and the United States, but the specific identity of the American and European examples is open to some doubt, whilst *Phryxus livornica* is represented in North America by the nearly allied representative species, *P. lineata*.

Tribe: EUMORPHIDI.

Our tribe *Eumorphidi* comprises many of the species that were formerly known as the Chœrocampids, a name given to them on account of the formation of the three thoracic segments and head, which form a sort of snout, and are more or less retractile within the swollen 1st and 2nd abdominal segments. The only really sedentary species—*porcellus*, *elpenor*—found in Britain, belonging to the *Eumorphinae*, are members of this tribe. The eggs are of the typical Sphingid form and colour, small for the size of the moth, but apparently with no especial characteristics. The larvæ exhibit many minute differences when compared with those of the Phryxids, their nearest allies. In tabulated form these differences work out as follows:

EUMORPHID LARVA.	PHRYXID LARVA.
1. Tubercles iv and v separate on 1st abdominal segment.	iv and v conjoined on 1st abdominal (in *euphorbiae*) [? a generic or specific character].
2. Caudal horn small (or aborted) in later stadia.	Caudal horn retained throughout all the stadia.
3. Thoracic segments retractile into tumid 1st and 2nd abdominal segments.	Thoracic segments not retractile; abdominal segments 1 and 2 not tumid.
4. Ocellated spots developed from subdorsal band on 1st and 2nd (and possibly other) abdominal segments.	No ocellated spots on special segments, but a chain of bright spots usually developed from subdorsal band on most (or all) of the segments.
5. Conjoined subsegments 1—3 of abdominal segments not specially marked in adult (*i.e.*, the character is waning).	Conjoined subsegments 1—3 of abdominal segments a marked feature of adult larva (*i.e.*, the character is not waning).
6. Pigment spots at the base of the shagreen (or secondary) hairs not specially developed.	Pigment spots strongly developed at the base of the shagreen (or secondary) hairs.

Weismann has treated (*Studies in Theory of Descent*, pp. 177-199) this group of larvæ at considerable length, but we cannot do more than

give his conclusions. On pp. 188 *et seq.* of this work he suggests that the remote ancestor of the Eumorphid or Chœrocampid larva was uniformly green without any markings; at a later period the white longitudinal subdorsal line made its appearance, then, at a still later period, this line vanished, with the exception of a few more or less distinct remnants, whilst, at the same time, from certain portions of it, the eye-spots of the 1st and 2nd abdominal segments became developed; after the perfecting of these eye-spots, weak repetitions of the latter appeared as black spots on all the segments except the last. Thus there are four chief stages in the phyletic development of the group: (1) Green larva without marking. (2) With a subdorsal line. (3) Development of eyespots on 1st and 2nd abdominal segments. (4) A repetition of rudimentary eye-spots on all remaining segments but the 12th. He then notes the following groups into which the larvæ fall:

1. Green, short oblique stripes over the legs, simple white subdorsal line, but no trace of eye-spots—*Clarina* † *syriaca*, Led., *Darapsa myron*, Cr., *D. choerilus*, Cr.

2. Subdorsal more or less retained, with eye-spot on the 1st and 2nd abdominal segments, imperfect traces in form of dark spots on succeeding segments—*Eumorpha elpenor*, L., *Theretra porcellus*, L., *Florina* † *japonica*, Bdv., *Hippotion celerio*, L*.

3. Subdorsal line retained to a variable degree, eye-spots on all the segments —*Lilina* † *bisecta*, Hors. (=*silhetensis*, Walk.), *Xylophanes oldenlandiae*, Fabr., *Isoples alecto*, L., *Pergesa acteus*, Cram., *Dilonche tersa*, L.

In the third group the subdorsal line varies much, in some it appears to have completely vanished *(Pergesa acteus)*, in others it is present as a light stripe running along all the segments *(Isoples alecto)*, whilst in others it is retained as a broad white stripe which only extends to the 4th segment *(Dilonche tersa)*. It is, however, an interesting fact that, even in this group, which has made the greatest step forward, the subdorsal line is of general occurrence, because the eye-spots in all these species may have almost a similar development to those of *elpenor* and *porcellus*. The third group appears to be purely tropical. Weismann considers that the great differences observed among the Chœrocampid larvæ can be very simply explained on the view that they stand at different levels of phyletic development, some species having remained far behind (group 1), others having advanced further (group 2), and others having reached the highest point of development (group 3). The fact that the species of the third group are only tropical accords well with this view, since many facts prove that phyletic development proceeds more rapidly in the tropics than in temperate climates. The striking markings of the Chœrocampid

* It is most remarkable that, whilst European entomologists (Buckler, *Larvae*, &c., iii., pl. xxv., fig. 2, Sepp, *Ins. Ned.*, viii., pl. 50) figure the larva of *celerio* as having eye-spots only on the 4th and 5th segments, Horsfield and Moore *(Cat. Lep. Ins. Mus. East India Company*, pl. xi) figure the larva of the Indian *celerio* with eye-spots on all the segments from the 4th to the 10th, the size diminishing from the front to the hindmost segments. It appears very doubtful whether two such dissimilar larvæ belong to the same species. Again, Staudinger obtained a larva of *alecto* from Beyrout with a very distinct subdorsal line, a beautiful eye-spot on the 4th segment, which is repeated with gradual diminution to segment 8, whilst Horsfield and Moore *(Cat. Lep. Ins. East Ind. Co.*, pl. x) figure the eye-spots as being perfectly alike on all the segments (see Weismann, *Studies in Theory of Descent*, pp. 193—198).

† Genus—*Clarina*, type *syriaca*. *Florina*, type *japonica*. *Lilina*, type *bisecta (silhetensis)*. *Acteus* might well stand as the type of *Pergesa*, and *oldenlandiae* of *Xylophanes*.

larvæ may be stated to originate from a local transformation of two portions of the subdorsal line into eye-spots, and the subsequent transference of these two primary ocellated spots to the other segments. The eye-spots always originate on segments 4 and 5, and from there the transference mostly occurs backwards, although, in certain cases, it takes place at the same time forwards. In the origin of the eye-spots then lies a great distinction between the Chœrocampids and Deilephilids, which were formerly associated, but in which the origin of a very similar kind of marking can be traced to quite another source. With a better knowledge of the larvæ of the Eumorphid species, one would expect considerable modification in their classification. We are even now without a knowledge of the early larval stages of many species, the adult larvæ and imagines of which were figured more than a century ago, and, until these are obtained, no real advance in the grouping of these species can be made. No doubt a complete detailed ontogeny of such species as *Daphnis nerii*, *Hippotion celerio*, *Xylophanes oldenlandiae* and *Florina japonica*, &c., might be obtained did lepidopterists know how important a knowledge of the early larval stages of these and allied species would be at the present time.

The Eumorphid *(sens. strict.)* pupæ *(porcellus* and *elpenor)* are very close to those of the Phryxids *(euphorbiae* and *gallii)* with the very important exception that they have developed certain head tubercles and certain abdominal spines, apparently with the object of enabling the pupa either to move within its puparium or to escape from it. Functionally and morphologically the abdominal spines are the same as those that exist in so many pupæ-incompletæ; they are for moving the pupa, and they are special modifications of the secondary hairs (as seen in larva), though, as to this view of their derivation, whilst they are undoubtedly modifications of hair-points, and these are again probably modifications of the spiculate skin-points, it is more probable that in the pupæ-incompletæ the spines are direct modifications of skin spicules, without the intermediate condition of modification into hairs. Their actual positions, as already noted, differ also. They are, in fact, a precisely similar, if not identical, structure developed *de novo*, without any genetic relationship to that of the pupæ-incompletæ. The pupa of *Eumorpha elpenor* cannot, in any other respects, be said to differ from that of *Hyles euphorbiae* to any important degree except in the surface sculpturing. The maxillary keel is a little more prominent and that is all. In that of *Theretra porcellus* the maxillary keel is very definitely more fully developed. The keel is more prominent, sharper, and has pushed the labrum a little further to the dorsum, and itself projects to the front of the pupa. Another point of distinction is that the surface sculpturing, which, in all this group, is wrinkling in front, and becomes pitting only on the later segments, is, in *porcellus*, wrinkling right away down to the 9th abdominal segment. It is possible that this is relative to the loss of the larval horn. In the larva, the horn preserves a primitive (comparatively) skin structure, long after it has disappeared from the rest of the surface. This conservative tendency of the horn may have some similar effect on the neighbouring cutaneous structure of the pupa. In comparing *Hemaris fuciformis* with *Pterogon proserpina*, we find

that wrinkling has almost entirely prevailed in *H. fuciformis*, whilst in the pupa of the hornless *P. proserpina* pitting is still the dominant sculpturing. *P. proserpina* and *H. fuciformis* are not, however, sufficiently close to make this comparison of any cogency. Again, in comparing the pupæ of *Phryxus (euphorbiae)* and *Thaumas (vespertilio)*, one concludes that, though wrinkling has made some advance into the abdominal segments in the former and very little in the latter, this is too far from the region of the horn to justify any conclusions. We see here, however, that *T. porcellus* and *E. elpenor* have made a considerable advance beyond the Phryxid group in the extension of wrinkling at the expense of pitting, and that the pupa of *E. elpenor* is still a little behind *T. porcellus* which has practically completed the process. The Phryxid *(euphorbiae)* group and the Eumorphid *(elpenor)* group are then equally specialised in the distinctive Sphingid characters, though *T. porcellus* has achieved a trifling advance. But the *elpenor* group has made a special advance in a direction not essentially Sphingid. When we compare these two groups with other Eumorphids, we find them far ahead of the primitive *Darapsa (myron, choerilus*, &c.), but far behind groups that we may typify by (1) *Sesia stellatarum* (2) *Isoples alecto*, (3) *Hippotion celerio*, (4) *Panacra vigil.* In all these, the maxillæ have much expanded and pushed the labrum to a dorsal position, the "keel" forming a great flange round the front of the head, and in (4) actually forming a tongue-horn. *S. stellatarum*, *H. celerio* and *Daphnis nerii* have a very thin and delicate pupa-skin and very similar coloration, and their structure, except perhaps that of *D. nerii*, is almost identical. Nevertheless, it is almost impossible to escape the belief that they are on three very different lines of development. They are specialised for a short pupal life amongst surface rubbish, and, specialising on Eumorphid lines with little other development (as in *E. elpenor)* to about the same level, have become very much alike. The pupa of *S. stellatarum* may always be distinguished by its antero-posterior flattening, which probably holds good for many other Sesiids. Though these groups are thus further advanced by special Sphingid progress, it is probable that they must be regarded as less specialised than the Phryxid, and Eumorphid *(sens. strict.)* groups by the persistence of pitting as against wrinkling of surface. But this certainly varies much within each group.

Genus: Eumorpha, Hübner.

Synonymy.—Genus: *Eumorpha*, "Tent.," p. 1 (1806); "Franck Cat.," p. 87 (1825); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 491 (1758); xiith ed., p. 801 (1767); "Faun. Suec.," ii., p. 288 (1761); Scop., "Ent. Carn.," p. 186 (1763); Müll., "Zool. Dan. Prod.," p. 116 (1776); Hfn., "Berl. Mag.," ii., p. 180 (1766); Fab., "Sys. Ent.," p. 543 (1775); "Spec. Ins.," ii., p. 148 (1781); "Mant.," ii., p. 97 (1787); "Ent. Syst.," iii., pt. 1, p. 372 (1793); [Schiff.,] "Schmett. Wien.," p. 43 (1775); Ill.'s n. Ausg., p. 17 (1801); Esp., "Schmett. Eur.," ii., p. 91, pl. ix., figs. 1—4 (1779); pl. xxvii., fig. 3 (1782); pl. xlv., fig. 1 (*circ.* 1801); Bergstr., "Sphing. Larv.," p. 10 (1782); Retz., "Gen. et Spec. Ins.," p. 34 (1783); Geoff., "Fourc. Ent. Paris.," ii., p. 254 (1785); Bkh., "Sys. Besch.," ii., pp. 66, 136, 178 (1789); Brahm, "Ins.-Kal.," ii., p. 528 (1791); Don., "Brit. Ins.," iv., p. 39, pl. cxxii (1795); Hb., "Eur. Schmett.," fig. 61 (1796); "Larv. Lep.," ii., Sph. iii., Legit., B *b*, fig. 2 *a—b* (*circ.* 1800); text p. 96 (*circ.* 1805); Schrank, "Faun. Boica," ii., 1, p. 227 (1801); Haw., "Lep. Brit.," i., p. 62 (1803); Latr., "Hist. Nat.," xiv., p. 131 (1805); Ochs.,

"Die Schmett.," ii., p. 209 (1808); Shaw and Nodder, "Viv. Nat.," xxi., pl. 988 (1810); Leach, "Edin. Encycl.," ix., p. 130 (1815); Dalm., "Vet. Ak. Handl.," xxxvii., p. 215 (1816); Lam., "Hist. Nat. Anim. sans Vert.," iv., p. 11 (1817); Samouelle, "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," iii., p. 46, pl. xviii (1821); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); Meig., "Eur. Schmett.," ii., p. 134 (1830); Zett., "Ins. Lapp.," p. 916 (1840); Evers., "Faun. Volg.-Ural.," p. 109 (1844); Assm., "Schmett. Schles.," ii., p. 32, pl. xi., figs. 34 *a—d* (1845); H.-Sch., "Sys. Bearb.," ii., p. 85 (1846); Speyer, "Geog. Verb.," i., p. 316 (1858); ii., p 280 (1862); Hein., "Schmett. Deutsch.," i., p. 145 (1859); Bang-Haas, "Nat. Tids.," (3), ix., p. 401 (1874). *Spinx*, Rudolph, "Handbuch," &c., p. 81 (1766). *Deilephila* [Lasp.], "Jena. Allg. Lit. Zeit.," iv., p. 100 (1809); Ochs., "Die Schmett.," iv., pp. 42—43 (1816); Curt., "Brit. Ent.," i., pl. iii (1823); Stephs., "Ill. Haust.," i., p. 131 (1828); "Cat. Br. Ins.," ii., p. 33 (1829); Bdv., "Icon. Chen.," pl. iv., figs. 1—2 (*circ.* 1840); "Gen. et Ind. Meth.," p. 46 (1840); Wood, "Ind. Ent.," fig. 18 (1839); Dup., "Icon. Chen.," pl. v., fig. 2 (*circ.* 1835); "Cat. Méth.," p. 42 (1844); Heydrch., "Lep. Eur. Cat. Meth.," ed. 1, p. 19 (1851); Staud., "Cat.," ed. 1, p. 16 (1861); 2nd ed., p. 37 (1871); Ramb., "Cat. Lép. And.," p. 131 (1866); Snell., "De Vlind.," p. 95 (1867); Berce, "Faun. Franç.," ii., p. 23 (1868); Mill., "Cat. Lép. Alp.-Mar.," p. 118 (1872); Cuní y Mart., "Cat. Lep. Barc.," p. 40 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 112 (1875); Frey, "Lep. Schweiz," p. 58 (1880); Minà-Pal., "Nat. Sic.," vii., p. 134 (1888); Auriv., "Nord. Fjär.," p. 46 (1889); Meyr., "Handbk.," p. 295 (1895); Bartel, "Palæark. Gross-Schmett.,' ii., p. 116 (1900). *Elpenor*, Oken, "Lehrb. Zool.," i., p. 760 (1815). *Oreus*, Hb., "Verz.," p. 136 (*circ.* 1822); Stephs., "Ill.," app. p. 5 (1834); "List Br. An. Br. Mus.," p. 29 (1850). *Choerocampa*, Dup., "Hist. Nat.," supp. ii., pp. 159, 160 (1835); Humph. & Westd., "Brit. Moths," i., p. 22 (1841); Dbldy., "List Brit. Lep.," p. 3 (1847); Sta., "Man.," i., p. 96 (1857); Humph., "Gen. Brit. Moths," p. 11 (1860); Wallgrn., "Skand. Het.," i., p. 44 (1863); Newm., "Ent.," iii., p. 127 (1866); "Brit. Moths," p. 10 (1869); Bdv., "Hist. Nat. Sphing.," p. 279 (1875); Kirby, "Eur. Butts. and Moths," p. 72, pl. xvi., fig. 3*a—c* (1879); "Handbook," &c., iv., p. 18 (1897); Auriv., "Sv. Vet. Hand.," xix., p. 137 (1882); Buckl., "Larvæ," &c., ii., p. 113, pl. xxv., fig. 3 (1887); Barr., "Brit. Lep., ii., p. 59 (1895); Tutt, "Brit. Moths," p. 29 (1896); South, "Ent.," xxxi., pp. 155, 228 (1898). *Metopsilus*, Dunc., "Brit. Moths," p. 161 (1836); Westd., "Gen. Synops.," p. 89 (1840). *Chaerocampa*, Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 554 (1876); Leech, "Proc. Zool. Soc. Lond.," 1888, p. 584 (1888); "Trans. Ent. Soc. Lond.," 1898, p. 282 (1898); Hamps., "Moths India," i., p. 84 (1892); Staud., "Cat.," 3rd ed., p. 103 (1901). *Theretra*, Kirby, "Cat.," p. 650 (1892).

The genus *Eumorpha* was founded by Hübner in 1806 (*Tent.*, p. 1), and *elpenor* fixed as the type. Hübner places it in his tribe iii of the Sphingids, and notes: EUMORPHÆ—*Eumorpha elpenor.* He had already described and figured the species as *Sphinx elpenor* (*Eur. Schmett.*, p. 61, and *Larvae Lep.*, ii., Sph. iii., Legit. B, b., figs. 2 *a-b*). Curtis, in 1824, fixed *elpenor* as the type of *Deilephila*, Lasp.; we have declared *elpenor* the type of *Elpenor*, Oken; Stephens, in 1850, cited *elpenor* as the type of *Oreus*, Hb., and Westwood, in 1840, cited *elpenor* as the type of *Metopsilus*, Dunc., so that *Deilephila*, *Elpenor*, *Oreus* and *Metopsilus* all fall as synonyms of *Eumorpha*, Hb., all having *elpenor* as the specific type. There is a very close alliance between *Eumorpha* and *Theretra*, of which *elpenor* and *porcellus* are respectively the types. The eggs are very similar. There is, however, considerable difference in the larvæ in their first instar, so far as relates to the development of the caudal horn; in *T. porcellus* it is merely a raised skin area, bearing tubercles i, whilst in the former it is a long dark crimson or purple bristly horn bearing i, as twin bristles, at the summit. The horn of *T. porcellus* has presumably been larger, and is now aborted to such an extent that, in size, it is less developed than in *Dimorpha versicolora* or even *Eutricha quercifolia* (Bacot). Chapman has already shown (*anteá*, pp. 58-59) that the pupa

of *Theretra (porcellus)* is rather more specialised than that of *Eumorpha (elpenor)*. He further writes: "The pupa of *Gurelca hyas* is the only one (of the few known to me) that has any direct bearing on the curious development of spines in the pupæ of *E. elpenor* and *T. porcellus*. This species has a facies very close to *Sesia (Macroglossa)* as an imago. The pupa, however, is much less so. It is cylindrical (not flattened) pale in colour (Eumorphid), pitted (wrinkling not advanced). The labrum is anterior, beginning to get dorsal. The pupa has, however, a peculiar ridge, just in the lines that the spines occupy in *E. elpenor*, which proceeds direct to the spiracle, which it appears to enclose, but rather more as if it went round it in front than behind. The ridge is dark coloured and smooth (free from spines); in front of the anterior one (on 5th segment) the surface is transversely wrinkled in contrast to pitting elsewhere. It suggests a *Darapsa* pupa that had advanced some way towards both *Eumorpha (elpenor)* and *Sesia (Macroglossa)*, with some special advance of its own." In the imagines it may be well to notice that *E. elpenor* has the first joint of the palpus about $\frac{2}{3}$ width of second, whilst *T. porcellus* has it only about $\frac{1}{3}$ to $\frac{1}{2}$ (Chapman). Hampson diagnoses the genus (*Ind. Moths*, i., p. 84) as:

Antennæ with the hook short and slight, the palpi moderately broad and quadrate at tip; apex of hindwing acute; the discocellulars oblique.

EUMORPHA ELPENOR, Linné.

SYNONYMY.—Species: *Elpenor*, Linn., "Sys. Nat.," xth ed., p. 491 (1758); xiith ed., p. 801 (1767), &c. *Porcus*, Retz., "Gen. et Spec. Ins.," p. 34 (1783). *Vitis*, Oken, "Lehrb. Zool.," i., p. 760 (1815). [NOTE.—This species has been known by Linné's name, *elpenor*, by every author of repute, except Retzius and Oken. The whole of the references mentioned under the generic synonymy (*Eumorpha*, *anteà*, pp. 59-60), except those relating to these authors, designate *elpenor* as the specific name of this insect.]

ORIGINAL DESCRIPTION.—*Sphinx elpenor*, alis integris viridi purpureoque variis: inferioribus basi atris. *Fn. Suec.*, 811. Mouff., *Ins.*, 183. Pet., *Gaz.*, t. 40, f. 11, 12, 17. Merian, *Ins.*, 2, t. 33, f. 73. Roes., *Ins.*, t.i., phal. 1., t. 4. Wilk., *Pap.*, ii., t. 1., B. 7. Raj, *Ins.*, 145, n. 2. Alb., *Ins.*, t. 9, f. 13. Frisch, *Ins.*, 12, t. 1. De Geer, *Ins.*, 1., t. 9, f. 8, 9. Habitat in Epilobio, Impatiente, Vite (Linné, *Sys. Nat.*, xth ed., p. 491). [Linné alters this to "*Sphinx*, alis integris virescentibus: fasciis purpureis variis; posticis rubris basi atris . . . . Differt a sequenti *(porcellus)* simillime; magnitudine dupla. Thorace a tergo lineis 4 longitudinalibus arcuatis rubris; abdominis tergo linea rubra longitudinali. Alis in medio puncto albo; primoribus margine interiore albis" (*Sys. Nat.*, xiith ed., p. 801.)]

IMAGO.—58mm.—74mm. Head ochreous-green with red lines from base of antennæ to front; thorax ochreous-green, rosy-red medially, with a longitudinal red line on either side and a white line at base of wings; abdomen ochreous-green, with red median longitudinal line, red laterally, a black patch on either side near base of hindwings. Anterior wings ochreous-green, with a fine rosy-red costal line; a glossy rosy-pink outer margin, commencing at apex and ending at anal angle; a glossy rosy-pink oblique line from costa near apex to inner margin (about one-third from anal angle), edged internally with purplish-red; an oblique line of

rather darker ground-colour crossing middle of wing, ending on inner margin towards base, a rosy-red patch (of varying size) lying on this towards base of wing; a black basal patch at lower edge of inner margin, edged below with long white scales; a fine white inner-marginal line; a small white discal spot; cilia of outer margin deep red, of inner margin white. Posterior wings, outer half bright rosy-red, darker marginally, the basal half black; cilia white.

SEXUAL DIMORPHISM.—In this species the sexes are very similar. The antennæ differ as is usual in Sphingids; they differ, however, further, in the antenna of the ♀ being very decidedly more slender than that of the ♂; both are about 12mm. long, and consist of about 60 joints, but that of the ♂ is about 0·40mm. in diameter, where at a corresponding point that of the ♀ is about 0·30mm. The scaling is in three rows, the first of very short scales hidden below the last row of the preceding segment, the second is a little irregular, and the third or terminal row is more regular, and the visible portions of the scales of this row, as compared with those of the preceding row, are in length as about 3 to 2. The anterior tibial spurs are larger and apparently of more complicated structure in the ♂. In both, the tibia is about 3·5mm. in length, and the spur is at about its middle, and so arises a little nearer the base in the ♂ than in the ♀, *viz.*, in the ♀ about 1·0mm. from the base, in the ♂ 0·8mm.; its length is 1·5mm. in the ♀, 2·2mm. in the ♂; the tibia extends beyond the spur about 1·0mm. in the ♀, and 0·6mm. in the ♂. It is difficult to say that there is any difference in form of wing, colouring, or marking, between the ♂ and ♀. There is, however, a somewhat different build, very obvious in living specimens, less so in the cabinet. The ♀ is more robust, and the abdomen diminishes to a sharp apical point in the last 2 or 3 (visible) segments, whilst that of the ♂ tapers more regularly to a similar sharp apex. On the first tarsal joint of the second pair of legs there is in both sexes a close series of fine spines just opposite the larger of the tibial spines. This does not occur in *T. porcellus* (Chapman).

GYNANDROMORPHISM.—Only one gynandromorphous example of this species appears to have been described. This reads as follows:

a. Halved. Left side ♂, right side ♀. The coloration of the two sides different. The left (♂) side strong rose-red; the right (♀) side on the forewing olive-green and dull red, hindwing albinistic towards the outer margin. Shape of the wings dissimilar, left longer and more slender. Left antenna male, right female. Shape of the abdomen female, though the anal point is developed in a crippled manner and glued together. Right wings 27mm., left 29mm. Bred at Berlin.—In the Wiskott coll. (Wiskott, *Festschrift*, &c., pp. 108—109).

TERATOLOGICAL EXAMPLE OF EUMORPHA ELPENOR.—Van Laer notices (*Alg. Konst en Letterbode*, 1847, pt. 2) that he captured an imago of *E. elpenor* with the left hindwing absent, but the forewing on the side where hindwing was lacking was larger than the other forewing, and showed also on its "inner-side" indications of the markings of the hindwings.

VARIATION.—This species, distributed as it is over the greater part of Asia and Europe, appears to offer considerable variation, and the Indian and Japanese races have been respectively described as distinct species, *viz.*, *rivularis*, Bdv. (=*macromera*, Butl. + *fraterna*, Butl.) and *lewisii*, Butl. Besides these races

there is considerable variation among the European examples, *e.g.*, Bartel notes (*Palaeark. Gross-Schmett.*, ii., p. 119) "that specimens vary greatly in size, examples smaller than *Theretra porcellus* being by no means rare. An extremely interesting aberration was bred many years ago at Osnabrück from an ordinary coloured larva. This was at one time in Heydenreich's collection, but is now in that of Wiskott. The rose colour of the forewing is entirely wanting, being replaced by an uniform chocolate-brown. The specimen figured and described by Esper (*Schmett. Eur.*, pl. xlv., fig. 1, p. 33) may belong to a similar aberration. It was bred at Frankfort-on-the-Main, and has, besides a considerable alteration of colour and markings, also much shorter wings than normal *E. elpenor.* This latter condition is perhaps attributable to crippling. The reddish, violet-tinged stripes of the forewings are, in this aberration, bluish-black, and the rest of the surface of the wing is red-brown, excepting the grey outer margin; the outer half of the hindwings corresponds in tint with the dark colour of the forewings. A further aberration is cited (*Iris*, viii., p. 170) by Karl Uffeln of Rietberg. This is normal as far as to the fourth abdominal segment which, however, is black and gives the specimen a peculiar appearance. Two albinistic forms, closely resembling one another, were described (*Ent. Zeit. Guben*, 1897, no. 9, p. 91) as follows: 'The general impression is quite that of very bleached specimens of *Eumorpha elpenor.* In place of the deep green of the type, they have a light orange-yellow colour with scarcely perceptible trace of green, while in place of the ordinary dark rose colour they are pale yellowish-grey.' On the forewings of an aberrant specimen which is described by Schultz (*Ill. Woch. für Ent.*, ii., p. 702), the red transverse stripes and margin are much less intense in colour than in typical specimens. The normally red parts are silvery-violet, and stand out on the olive-green ground-colour much less prominently than usual. A further aberration is mentioned (*loc. cit.*, p. 706) in which the red of the hindwings is entirely wanting, being replaced by a dirty-white colour, and the right forewing is partially albinistic. Unfortunately the specimen is a complete cripple. Examples from the Amur region vary somewhat amongst themselves, but agree almost entirely with European. The same applies also to specimens of *E. elpenor* from China. Specimens from Corea are less dark-coloured and more like the European than those from Japan." Bartel adds that "specimens from southern and eastern Asia have received several names. Thus Butler has erected two separate species on different sexes * of the Indian specimens, but these cannot even be adduced as separate varieties, as transitions from one form to the other are present, and the two show no characteristic distinctions at all." Herz describes a very small male from the banks of the river Wittim in northwest Siberia (*Iris*, xi., p. 250). Bishopp records an aberration, bred in 1870, which, instead of being of the usual olive-green and pink tints, is of an uniform grey, with just a little olive-green on the body; on June 23rd, the same lepidopterist

* This is not so (see *posteà*, p. 65), where it is stated that both sexes occur in each of the two forms.

records (*Ent.*, vi., p. 485) another aberration, also bred at Ipswich, of an uniform olive-green colour, excepting the abdomen, which is tipped with bright pink. In 1871, Bond exhibited another Ipswich specimen in which the central portion of each forewing was perfectly hyaline and free from scales. It is figured and described (*Ent.*, vi., p. 81, fig.) as follows: "The forewings have a large central area, in which the membrane is without scales, the wing-rays only being furnished with scales, and these ochreous; the rest of the wing is smoky-brown. In the hindwings is a similar central area, but not so completely denuded of scales as that in the forewings; at the apical angle the wings are smoky-brown and partially of the same colour as the forewings, but the scales towards the anal angle and nearer the centre of the wing are dull ochreous. The palpi, crown of the head and collar are dull olive-brown; the thorax ochreous-brown, tinged with rosy, the abdomen brown, the margins of the segments ochreous, and the tip rosy." There is considerable minor variation in our British examples. In many, the bright ochreous-green assumes a duller tint, and the red shades and areas on the forewings are of a dull purplish or violet, and much restricted in area at the centre and towards the base of the forewing, whilst the outermargin of the hindwings is paler in colour (ab. *pallida*, n. ab.). In some examples, the outermargin of the hindwing is shaded with a tint approaching the ground-colour of the forewing to such an extent as to restrict the pinkish area to a transverse band just outside the middle of the wing (=ab. *virgata*, n. ab.), whilst in others, the outer marginal area of the hindwings is, on the other hand, sometimes quite whitish. Some examples, otherwise well coloured, have no red markings at the centre of the forewings, except as a shade on the inner edge of the second oblique line, and, rarely, extreme forms have the forewings uniformly ochreous-green (= ab. *unicolor*, n. ab.). A greenish-ochreous tinge is occasionally carried over the apical area of the hindwings. On the other hand some examples have all the red markings of the fore- and hindwings brilliantly rosy-red, extending into a large patch towards the base of the forewings, and developed as an unusually broad outer marginal area on the hindwings (=ab. *clara*, n. ab.). Occasionally the white discal spot of the forewings is absent (= ab. *obsoleta*, n. ab.). The only described forms of this species are as follows:

a. var. *lewisii*, Butl., "Proc. Zool. Soc. Lond.," 1875, p. 247 (1875); Kirby, "Cat.," p. 650 (1892); Bart., "Pal. Gross-Schmett.," ii., p. 121 (1900). *Elpenor*, Leech, "Trans. Ent. Soc. Lond.," 1898, p. 282 (1898).—*Imago*: Very like *C. elpenor*, but duller above, the rosy streaks on primaries less evident, primaries below with the golden discal patch not extending (except as a fine line) below lower radial. Expanse of wings 2 inches 10 lines. Japan. *Larva*: Very distinct from that of *C. elpenor*, brown or green. The brown larva differs principally in having the lower surface and lateral area of the last seven segments brown, with a defined, undate, sinuate internal edge, each sinuosity answering to the convex margin of its segment; the two eye-like spots are much smaller, and have pale brownish centres in both forms of the larva; the horn in the green form is longer but less curved than in the brown form. It feeds on fuchsia and balsam. [Without having seen the excellent figures of the transformations obtained by Mr. Lewis, I should not for a moment have thought this species distinct from *C. elpenor*.] (Butler).

Bremer and Grey (*Schmetterlings-Fauna des N. China's*, p. 11) note this species amongst their list of Pekin lepidoptera,

but without any remarks as to its abundance or time of appearance. Leech says (*Proc. Zool. Soc. Lond.*, 1888, p. 584):—"Except that some examples are more rosy than the type, the specimens from Oiwake, in Pryer's collection, and others I took at Shimonoseki and Gensan in July, are not separable from *C. elpenor*. Localities: Oiwake (Pryer); Shimonoseki, Gensan (Leech); Kiukiang (Pratt); Hakodaté (Fletcher)." On July 8th, 1897, when we were at Gensan, I had a specimen of this species brought to me; it had been attracted to light on board. On September 13th, 1897, I found at Endermo (or Mororan), near Hakodaté, a larva, which soon pupated and I bred a fine imago therefrom. On May 8th, 1899, whilst at Chifu, I had another good specimen of this species brought to me, which seems a little darker than my Korean and Japanese examples (Fletcher). Hampson notes (*Ind. Moths*, p. 85) that "typical *elpenor* (= *lewisii*) from Europe, Japan and northwest India is smaller, with the pink on the hindwing and underside rather less developed; whilst in the form *fraterna* from the Western Himalayas, the colour is rather duller and the pink on the underside more evenly disposed over the disk of both wings than in the eastern form, *macromera*."

β. var. (an sp. dist.) *rivularis*, Bdv., "Hist. Nat. Insectes," i., p. 280 (1875).—Although the larva of this species, after Shervill's drawing, is marbled with brown and whitish, we only doubtfully separate it from *elpenor*, of which it is probably only an Indian variety. At first sight it differs from *elpenor* in that all the rosy parts are of an obscure rosy-violet, the second oblique band of the forewings is terminated on the costal edge before the apical point, the stigmata more marked, the antennæ are not rose-coloured, and, lastly, that the corselet is almost entirely olive, marked slightly with rose; otherwise, it has the same characters as *elpenor*. Simla, Darjeeling (reared by Mr. Shervill); several in the B. M. collection (Boisduval).

Butler's two Indian Eumorphids—*fraterna* and *macromera*—are by some authors, *e.g.*, Bartel, supposed to be merely the two sexes of the same Indian form, but this is not so, as both sexes occur in each of the two forms. As a matter of fact, *fraterna*, Btl., is identical with *rivularis*, Bdv., and *rivularis* (=*fraterna*) may be looked upon as a dark-coloured variety or local race of *E. elpenor*, whilst *macromera* would seem to be merely a paler aberration of the Indian race, and approaches more nearly typical *E. elpenor*, with characteristics as given by Butler, both forms agreeing in having more elongated and pointed hindwings than *E. elpenor*. But typical *E. elpenor* also occurs in India, for there is such a specimen labelled "Shillong" in the British Museum collection. There is, indeed, much to be said in favour of considering *rivularis* a distinct species, *e.g.*, it is remarkable in its neuration, has nervures 6 and 7 of the hindwings more often than not stalked, and possibly has other marked characters (Kaye). On the other hand, other authors have considered the two forms as distinct varieties of *E. elpenor*, so that, for the use of students, we append Butler's original descriptions:

1. *macromera*, Butl., "Proc. Zool. Soc. Lond.," 1875, p. 7.—Nearly allied to *C. elpenor*, but much larger; the primaries duller in colour, with the outer margin more broadly rosy lilacine; secondaries with more than half the wing rosy; body with the dorsal rosy line less defined; wings below with the costal ochraceous border duller, much narrower, only clearly represented towards base; transverse band converted into two narrow parallel lines. Expanse of wings 3 inches 4 lines. Silhet (Macgillivray), North India (Stevens). Type—B. M. coll. [Noted by Mr. Walker as a variety of *C. elpenor*. I am satisfied, however (from the fact that the

more nearly allied Japanese species is now proved by breeding to be distinct), that it is a different species] (Butler). 2. *fraterna*, Butl., "Proc. Zool. Soc. Lond.," 1875, p. 247.—General aspect of *C. macromera*, but duller; primaries above golden-olivaceous, with the two oblique bands and border dull greyish-pink; secondaries with basal half dull black, external half dull pink, fringe whitish; body altogether duller; wings below bright rose-red, costa ochreous, a central grey-brown transverse line; basal half of primaries brown, clothed to first median branch with ochreous and pink hairs: body below rose-red, abdomen with lateral white dots. Expanse of wings 3 inches 2 lines. Simla (coll. F. Moore), N. India.

Egglaying.—Usually laid singly, or more rarely two or three together, on the underside of the leaves of *Galium palustre*, usually attached just where the leaves join the stem. Eggs found by searching at Potter Heigham, June 19th-20th, 1896 (Bacot). Laid singly on the underside of the leaves of *Galium palustre*, *Epilobium angustifolium*, and more rarely on *E. hirsutum;* sometimes two eggs are found on one leaf, and once I found two in contact, but as a rule they are placed singly. Eggs found by searching, July 15th-16th, 1901, on which date, besides three smaller larvæ, one about three-quarters grown and another 3 inches in length were found, a sufficient illustration of the difficulty of fixing any particular date for the time of egg-laying, even in a single year. The plants must be most carefully examined or the eggs may very easily be missed (Ransom). Eggs taken on wild balsam at Godalming on July 8th, 1901, young larvæ being found on same date (Latter, *in litt.)*. Enclosed ♀ on a bunch of *Galium palustre*, she oviposited in due course, the similarity of the eggs to the seed-pods of this plant is noticeable; the egg-stage only lasted 7 days (Butler, *in litt.*). In the Reading district the eggs appear usually to be laid two or three together on a leaf (Holland); laid singly at the end of June on the leaves of *Epilobium hirsutum* and *Circaea luteiiana*, also, in London gardens, on the several varieties of fuchsia (Newman).

Ovum.—1·5mm. in length, 1·3mm. in width, 1·2mm. in height; rather a short, rounded oval, colour green (less vivid than that of the Amorphid eggs) matching well the colour of the leaves of *Galium palustre;* the surface shiny; the surface reticulation faintly but clearly marked (Bacot). Of a pale green colour, almost circular in outline, but still just a little longer than wide; the shell apparently smooth, but covered with a faint surface reticulation; a distinct depression on the upper surface of egg; the micropyle is very indistinct and consists of a finely pitted depression at one end of the egg. When the embryo is fully formed, the eggshell is transparent and has an iridescent gloss *(Ent. Rec.*, ix., p. 237), 1·5mm. in length, 1·25mm. in width, oval, approaching circular in outline, somewhat flattened on upper surface; colour bright green, becoming yellow-green as development proceeds; surface faintly reticulated, the reticulations much clearer towards the two ends, especially the micropylar, which is somewhat broader than its nadir. The micropylar depression is marked and the stellate centre is discernible (Tutt, July 9th, 1901. Eggs on *Impatiens*). The eggs are nearly spherical, but somewhat compressed, of a grass-green colour, a little lighter and somewhat larger (1·2mm.) than those of *Hyles euphorbiae*. During the development of the embryo the eggs first became yellowish-green and finally yellowish (Weismann).

Habits of larva.—The most remarkable larval habit seems to me to be the rapidity with which it reaches maturity—16 days from egg to the last stadium; it spends, however, a week or ten days in this stage, even then its whole larval period is less than a month (Bacot). Of this Garbowski observes that the larvæ are, in Galicia, especially fond of *Ampelopsis quinquefolia*, on which they are more easily and most rapidly reared, the first moult taking place on the 3rd day, and the going to earth occurring on the 18th day, after hatching. The young larvæ may be found by careful searching, wherever, by the sides of ditches and rivers, the foodplants show signs of being eaten; they appear to feed by day, and do not, when they get older, make any attempt to hide except when moulting, when they always appear to wander from the foodplant; often the search of a well-eaten plant has proved unsuccessful, when, two or three days later, a larva that could not possibly have been overlooked has been found on the very plant; they do sometimes, however, moult on the foodplant, and I have seen a cast skin adhering to a stalk of *Galium palustre*. One egg, found in 1901, hatched July 16th, the larva underwent its last moult on August 4th, was fullfed and spun its cocoon on August 14th, but did not change to pupa till August 21st. At the time of moulting the larva has all the appearance of dying, one that I observed carefully was lying for a time on its side quite motionless, the skin turning a whitish colour, and a white line appearing along the sides; the skin broke behind the head, splitting round the latter, and enabling the larva to draw out its true legs; the larva then literally walked out of the old skin, which immediately shrivelled up (Ransom). The larvæ, when young, are well-hidden away in the tufts of the foodplant, but when large they often lie out exposed, and are readily seen; if you find one larva on a plant, you usually find another, sometimes two more, on the same plant (Holland). The fullgrown larva rests on the twigs of *Fuchsia*, stretched at its full length, and holding by the third pair of legs as well as by the ventral and anal claspers; the head is bent under, touching the twig, but the "Sphinx" attitude is not assumed; viewed from the front the resemblance to a pig's head is very striking, the head of the larva representing the flattened disk of the pig's snout, and two ocellated spots on the 4th segment the pig's eyes (Newman). It is well-known that the larva usually inhabits marshy places, and hence its foodplants grow by, or even in, the water. The larvæ may be found, in such places, stretched at length on *Galium palustre* in the day, and also with a lantern feeding voraciously at night (Tutt)*. Albin remarks that there is "something in this caterpillar very remarkable, *viz.*, its dexterity in swimming, for, commonly feeding in or near the water, if, at any time, it happens to fall in, it turns on its back, and swims with its head and tail turned together, till it gets hold of some part of the plant, by which it helps itself up again." Hellins remarks that this proceeding is more like floating, unless there is a "movement to

* These observations are not quite in consonance with the observations of Weismann (*posteà*, p. 74), who finds the younger larvæ well up on the plants, the older low down upon or near the ground.

and fro of the head and tail." Harris also, in 1749, refers to the habit, and states that when a larva falls into the water it immediately rises to the top of the water, where it remains till its struggles or the currents drive it to some plant, by means of which it can crawl out and save itself. He suggests that the swollen 1st and 2nd abdominal segments contain air that assists them to keep on the surface, and he noticed that one that had fallen into the water kept the thoracic segments above, the swollen segments being even with, the surface. Corbin notes that two larvæ, carried several miles in a bottle of water by a boy, were taken out, soon recovered their normal vitality, fed up on fuchsia and pupated. Chaumette observes that the three anterior segments are extended or contracted, according as the larva is feeding, walking, or in a state of repose, and, when contracted, they are drawn into the 4th segment. The following details of the dates when larvæ have been observed may prove interesting: Larvæ are to be found from July-September in the Linz district, 19 fullfed larvæ were captured in early September, 1896, at Buchenau (Himsl), two dozen larvæ found on *Epilobium* in a wood at Braunfels, on August 13th, 1900 (Sich), August at Romsey (Buckell), larvæ abundant from 2nd week in August to the end of September at Maidstone (Gandy), August 11th-24th, 1856, larvæ at Cambridge (Farren), larvæ August 15th, 1856, spun up August 21st at Bisterne, near Ringwood (*Subs.*, p. 20), larva fullfed at Sherwood Forest on August 27th, 1856 (Pickard), fullgrown larva at Cuckfield on August 14th, 1857, pupated August 19th (Merrifield), August 26th, 1857, larvæ at Ilfracombe (Mathew), August 4th-17th, 1858, in Hammersmith Marshes (Gorham), September 26th, 1860 (ichneumoned), October, 1867 (ichneumoned), at Folkestone (T. Briggs), larvæ common in September in the marshes at Deal, August 11th, 1866, at Thame, August 6th-8th, 1867, at Deal, July 22nd, 1874, larvæ abundant at Lee—4 dozen taken, August, 1874, at Catford, August 23rd-29th, 1888, September 24th, 1894, at Deal, August 30th, 1896, at Dartford (Fenn), August 8th, 1867, at Deal (Jones), in the hot summer of 1868, near Penzance, larvæ on bogbean in July, these pupated same month, and two imagines, after pupal period of fortnight, emerged August 5th, 1868 (Matthews), July 15th, 1870, August 17th, 1875, August 17th, 1897, August 9th-10th, 1899, August 4th, 1900, at Oxton (Studd), larvæ from June 22nd-August 3rd, 1878, at Wicken Fen, July 16th-28th, 1879, at Cleethorpes (Porritt), July 13th, 1878, larva at Brandon, larvæ fullfed on August 15th, 1900, at Oxton (Bower), September 13th, 1878, at Taunton (Parish), larvæ end of August, 1881, at Ipswich, August 23rd, 27th, 30th, September 1st, 1895, at Freshwater (Mera), August 11th, 1882, at Henley, August 3rd 1883, at Bulmershe Park, August 5th, 1889, about 50 fullfed at Reading, August 14th, 1892, fullfed at Sulham, August 15th, 1896, at Oxford, August 2nd, 1898, at Caversham (Holland), larvæ August 22nd, 1882, at Stamford Hill, August 3rd, 1894, at Horning (Sheldon), August 25th, 1885, all pupated by September 7th at Painswick (Watkins), September 17th-19th, 1885, at the Lizard (Riding), larvæ September 9th, 1887, at Brentwood, August 13th, 1897, at Bentley (Burrows), larvæ nearly fullfed August 3rd, 1888, August 19th, 1894, August 11th, 1895, August 16th, 1896,

at Reading (Butler), larvæ fullfed August 20th, 1889, at Aylsham (Freeman), July 29th, 1891, larvæ at Horning (Bowles), August, 1892, at Folkestone (Byrne), larva August 3rd, 1892, at Guildford (Grover), larva August 18th, 1892, at Harrow (Rhoades-Smith), July 15th-24th, 1893, at Wicken (Mitchell), August 25th-September 2nd, 1894, August 19th, 1895, August 15th-27th, 1897, August 3rd-28th, 1898, July 19th-24th, 1899, July 16th-September 3rd, 1900, at Sudbury, July 22nd-24th, 1896, August 11th-17th, 1897, May 25th, 1898, July 31st-August 18th, 1899, July 18th-August 12th, 1900, July 14th-August 18th, 1901, at Henny, August 21st, 1898, at Borley (Ransom), larvæ August 30th, 1894, fullfed September 1st (Glenny), fullfed larvæ on July 21st, 1896, at Church Stretton (Newnham), larvæ at Wicken from August 18th-25th, 1895 (Brady), larvæ common at Warminster in August, 1896, August 4th, 1898, a single larva at Tullylagan (Greer), larva fullgrown August 4th, 1896, larvæ fullfed August 17th-18th, 1899, at Chelmsford (Miller), larvæ September, 1896, at Penmaenmaur (Bland), larvæ August 8th-22nd, 1897, on the banks of the Stour (Wilson), August 12th, 1898, at Epping (Image), larva on willow-herb, August 24th, 1898, at Stalham (Edelsten), September 9th, 1898, fullfed larva, September 15th, 1899, larvæ at Lakeside, Windermere (Moss), 50 larvæ during the first three weeks of August, 1900, and August 1st-20th, 1901, larvæ common at Rye (Henderson), larvæ August and September, 1900, at Southampton and Winchester (Moberly), fullfed August 24th, 1900, in the Frensham dist. (Bingham-Newland).

The terrifying attitude of Eumorpha elpenor.—Weismann deals at length (*Studies in the Theory of Descent*, pp. 327 *et seq.*) with the formation of the ocellated spots in Eumorphid larvæ and their possible significance. He shows that the primary ocelli originate on the 1st and 2nd abdominal segments by the detachment of a curved portion of the subdorsal line, this fragment becoming the "mirror," and acquiring a dark encircling zone, "the ground area," the nucleus or "pupil" being added subsequently. He points out that these spots make the larvæ more easy of detection than otherwise, and that they appear to possess a biological value as a means of terrifying their enemies. He observes that the ocellated Eumorphid larvæ remain quiet on being attacked, that they merely withdraw the head and thoracic segments into the swollen 1st and 2nd abdominal segments, and that the large ocellated spots being situated on these swollen segments, the larva assumes an aspect which he shows by experiment (*loc. cit.*, pp. 331-334) is most alarming to certain small birds. He concludes that the advantage of the protective coloration of such larvæ remains as strong as ever, and aids the concealment of the larvæ, that these markings are of service to the larvæ when attacked, and that they thus serve as a second means of defence, resorted to when the protective coloration has failed. Poulton observes (*Trans. Ent. Soc. London*, 1886, p. 154) that it is specially to be noticed that the terrifying appearance due to these markings, would be effective only against an enemy approaching from the side or from above, but would produce very little, if any, effect upon an enemy advancing from the front. He points out as a fact that seems to have escaped the notice of Weismann, although it is really

described in his account of the larva of *T. porcellus* as well as that of *E. elpenor* (*Studies in Theory of Descent*, pp. 182, 187), that, when looked at from the front, a larva in this attitude exhibits another pair of ocellated marks, which appear as such in the defensive attitude only, upon the 3rd thoracic segment. The "mirror" of this spot is formed by the posterior end of the white subdorsal, the "ground-area" by the black patch which encircles the former except anteriorly, but there is no trace of a nucleus as in the spots on the 1st and 2nd abdominal segments . . . and Poulton points out that, when the larva assumes the terrifying attitude and the head and thoracic segments are telescoped into the 1st abdominal, the swollen anterior end of the body is abruptly truncated, and, when looked at from the front, appears as a flattish circular face marked by deep concentric furrows, which are the lines between the segments and between the annuli which are upon the latter. The result of these deep furrows, and of the shortening of the subdorsal is to render the latter, and its deep margins, inconspicuous, except in the posterior part of their length, where they become broadened, shortened, and rendered very prominent, as two eye-like marks, one on each side of the median line and towards the upper margin of the face-like extremity of the larva. Their position is, therefore, exactly that which, better than any other, produces the effect of eyes upon an enemy approaching from the front. Although the white "mirror" is not completely encircled by the ground-area, no impression of imperfection is produced and the effect of the furrows and contraction is such as not to suggest the continuity of the eye-like parts of the subdorsal and its margins with the rest of these markings on the anterior thoracic segments. These two eye-like marks differ from the others in that they only possess significance in the terrifying attitude, being quite unrecognisable as eyes in any other position. This must certainly add to the effect of the suddenly assumed protective attitude, when, in addition to the changed contour of the larva and the prominence given to the large eye-spots, with equal suddenness new terrifying marks seem, as it were, to spring into existence.

Larva.—*First instar* (newly-hatched): The newly-hatched larva of *E. elpenor* has the head and body yellow-green in colour, the legs and prolegs paler and almost transparent; the caudal horn long in proportion to the length of the larva, black in colour, and slightly bifid at tip (*Ent. Rec.*, ix., p. 237). Length on hatching 4·5mm., pale green in colour, changing after a few hours to dark grey; segmental incisions appear as white rings, due to overlapping of skin. Head rounded, pale green, with a few small scattered hairs thereon; slightly wider than prothorax, but not large for size of larva. Prothoracic scutellum large, but not distinct, more opaque in colour than the head. Tubercles i and ii on meso- and metathorax placed trapezoidally on separate sub-segments, iii is double on these segments, and only one subspiracular hair (v) is traceable; i and ii on abdominal segments in the usual trapezoidal form, the anteriors (i) on the 8th abdominal segment being on the summit of caudal horn; iii is a single-haired tubercle, iv is single-haired below spiracle; each of the tubercles bears a single, very short, light-coloured seta, slightly knobbed at tip. The caudal

horn is dark purple-red, almost black, in colour, long (about one-third of length of larva), roughened, thickly covered with short spicules (a rather well-developed horn for a newly-emerged larva); no trace of shagreen-hairs or spicular skin-points except on the horn (July 3rd, 1896). About to undergo 1st moult, length about 8mm.; colour pale shining green; the subdorsal lines, shagreen dots, and a very faint and narrow lateral line are visible through the old skin (July 9th, 1896). *Second instar:* Head bright green; rounded, but inclined to be tall, and somewhat square at top; division of lobes distinct; small compared with size of body; a few scattered hairs as in 1st instar. Body bright green, but with a whitish tinge caused by the shagreen tubercles, each bearing one short hair, which put in an appearance at this stage; the prothorax and mesothorax small, the metathorax and 1st abdominal segment large, the incision between the latter very slightly marked; other incisions distinct (with exception of that between 7—8), owing to overlapping of skin; a dark mediodorsal line present, appears not to be a skin-marking, but the dorsal vessel; faint green spiracular, and stronger whitish, subdorsal lines present; the subdorsals start on either side of head, run back to the 8th abdominal, and then slope upwards to base of caudal horn; each thickens into a small lunule on the 1st and 2nd abdominal segments, more strongly on the 1st; this is the first sign of the development of the marked ocellated spot of the mature larva. The caudal horn is stiff, shiny, straight, rather longer than the thickness of larva, reddish at base, black above; less rough than in 1st instar; the raised points being less like prickles and each bears one comparatively long hair; the apex is forked, each branch bearing a rather long hair (the setæ of tubercles i); each shagreen tubercle bears a very short hair which appears to be knobbed (not forked); there appear to be 8 subsegments to each of the segments (July 19th, 1896; but from a different larva from that of which 1st instar description was made). *Third instar:* Length 19mm.-25mm.; head very small for size of larva, surface dull, colour clear green, shape as in 2nd instar; body bright green; prothorax very little larger than head, mesothorax rather larger, metathorax large, though not so large as the 1st and 2nd abdominal segments which are rather larger than the remaining abdominal segments. The head, prothorax and mesothorax, retractile; they were slightly so in 2nd instar. The subdorsal lines faint on metathorax and 1st and 2nd abdominal segments; the anticipatory lunuiar markings of preceding instar rather higher, much stronger, of a bright cream-colour, bordered beneath with black (the black border is absent in one larva in this instar), the subdorsal band more distinctly marked on remaining abdominal segments than in previous instar, being bordered above by clear green, due to the whitish colour which spreads from the base of the shagreen-hairs, being less strong here than on the rest of the body. The lateral spiracular line has disappeared, but the oblique stripes are faintly marked, and are broad dashes like those of the larva of *Sphinx ligustri*, the 1st and 2nd and the lower part of the 7th are very faint, the upper part of the 7th joins the subdorsal line and is very strong; they seem to be formed as in the Amorphid larvæ by the massing of the shagreen

tubercles. The caudal horn is black, shorter than in preceding instar. Hairs very short, those on caudal horn longer than those on body; the shagreen tubercles on area of future ocellated spots are mere specks (July 12th, 1896). *Fourth instar:* 25mm. growing to 43mm. at end of instar; head, as in last instar, very small for size of larva. Body green in colour (but dark forms occur in this stadium). Head, prothorax and mesothorax now strongly retractile; the metathorax and 1st and 2nd abdominals much swollen. The dark mediodorsal line still present; the subdorsal broad, not so distinct as in previous instar, strong on 8th abdominal, and bordered with dark brown on the upper side; the oblique lines only faintly marked, although in some instances bordered with dark brown or black; the ocellated spots now strongly marked, the lunule large and bright, the upper half yellow, the lower half bright pink, surrounded by a narrow black line, on the under side this black border is enlarged into a velvety-black blotch, often with a small detached spot beneath, rather stronger on the 1st than on the 2nd abdominal; the pink lower border of the ocellated spots in 4th instar becomes gradually surrounded by the yellow and is left as a pink lunule in the centre of the yellow one. One of the larvæ has strongly marked black blotches on each segment just above the subdorsal line, and a black blotch on the posterior mediodorsal portion of each segment; it is also faintly mottled with black all over the dorsal area. The caudal horn still prominent in some larvæ, stiff, pointed, slightly curved, shiny, black, but with white tip (July 15th, 1896). *Fifth instar* (the last): Bright green in colour, mottled with paler green specks (shagreen spots). Head rather tall, rounded in shape, very small, of a duller green tint than body, mottled with darker green on face. Prothoracic scutellum also darker green than rest of body. The markings on the body as in preceding instar, but rather stronger; the spiracles dark; the subdorsal stripes on thoracic segments bordered both above and below with black (very strongly marked on anterior half of metathorax); the ocellated spots now very prominent, the central area dark greenish-brown, extending to lunule, bordered with yellow above and blue beneath, the black border very strong, especially the lower part of that on the 1st abdominal, almost equally so on both the upper and lower parts on that on the 2nd abdominal. [One suspects that the clearly-marked portion of the subdorsal line on the metathorax with its deep black borders is the commencement or remnant of another ocellated spot, and it suggests how this characteristic style of marking possibly originated.] Caudal horn mounted on a pyramidal-shaped hump, the horn itself very small and insignificant (July 19th, 1896) (Bacot). *Fullgrown larva:* About 70mm. in length, stout from the 1st to the 8th abdominal segment, being widest at the 1st and 2nd abdominal segments. The thoracic segments taper rapidly to the head, which is small and round. The head, prothorax, and mesothorax can be retracted into the metathorax, which then becomes puffed. There is a small, curved, rough caudal horn, 2mm. long, on the 8th abdominal segment. The skin generally smooth (Hellins). Newman also describes the fullfed larva (*Ent.*, iii., pp. 127—128).

VARIATION OF LARVA.—Albin described the green and brown forms

in 1749, noting that the larvæ were taken on June 26th, were full-fed on July 7th, the imagines emerging on April 15th of the following year. Harris, in the *Aurelian*, notes the green and brown larvæ as belonging to different sexes, the green being ♀, the brown ♂. Hellins says that, in colour, there are two main varieties: (1) This form has the ground-colour a sort of mouse-brown, buff at the folds, covered with a network of blackish freckles, except on the thoracic segments. These have a subdorsal line of dusky buff enclosed in a blackish border which, on the metathorax, swells out into a blacker blotch. The 1st and 2nd abdominal segments have each, at the subdorsal level, a large blackish blotch enclosing in its upper half a lilac, kidney-shaped spot, the centre of which is olive in colour, and, at the commencement of each segment at the subdorsal level, the black freckles are more distinct and deep in tint. The head and horn are dull black, and there is, on the 8th abdominal, a black V with its tip at the caudal horn. The spiracles are dusky buff, ringed with black. The belly is buffish, freckled with a smaller pattern than that on the back, the legs dusky. (2) The second form has the ground-colour dull green, paler at the folds, with traces of black-brown network of freckles, most distinct as a subdorsal patch on the front of each segment; there is also a dorsal line of freckles. The subdorsal line on the thoracic segments and the blotches on the 1st and 2nd abdominal segments as in the other variety. The spiracles pale brownish, with dark rings; the ventral area dusky-green; the caudal horn and the V-mark on the 8th abdominal segment black. Bacot observes that of six larvæ that hatched from Norfolk ova, all were green until the 3rd moult, and that one then obtained the dusky coloration that is usual with adult larvæ; in this larva the usual markings were present, but they were dark grey-brown, lighter than the general ground-colour; the black spots on each segment, just above the subdorsal lines, present, and, with these exceptions, all the other markings clearer and more distinct than in the green form. The remaining five larvæ were green in the 4th instar, one being entirely green, three with black spots above the subdorsal band and below the stripes; the remaining one was without spots. In the black form the spiracles were white; in the green form black. Chaumette writes (*Zool.*, ix., p. 3100) that the ground-colour varies from a fine apple-green to dark brown, variously variegated with small dusky lines; the dark individuals having much resemblance to the colour of the Spanish radish. The sides of the 4th and 5th segments are each ornamented with a large eye-like spot of a shining black colour (ocellus), on the upper half of which is a large reniform spot of a light greyish-olive colour, lighter towards the sides; also two dark oblong patches on either side of the 3rd segment, from which proceed two dusky longitudinal lines towards the head; there are also faint traces of a dusky dorsal line; there is generally an interrupted longitudinal line on either side in a line with the ocelli; sometimes there are traces of a dusky interrupted lateral line, and, often, especially in the darker individuals, there is a series of pale oblique stripes. In the dark specimens, the anterior segments are of a much lighter colour than in the others; the caudal

horn dark brown or black, tipped with white, with two short dark oblique stripes joining the base of it. Head, abdomen and prolegs varying according to the colour of the body, thoracic legs pale flesh colour; stigmata brownish-yellow bordered with black, but variable. James notes one nearly black larva at Deal, one brown and two green ones at Rickmansworth, one dark brown one at Broxbourne, and Russell records that larvæ taken on the banks of the Basingstoke canal from water-bedstraw were in various stages, some nearly fullfed, others very small; half of them were green in colour (the small ones) and half black. In confinement all the green ones in moulting changed to black and pupated when of that colour. Hammond describes (*Ent.*, xiii., p. 280) a form of the larva as: Light brown; on 5th and 6th segments a velvety-black ocellated spot, with a kidney-shaped whitish spot within the black; on the 6th, 7th, 8th, 9th and 10th segments an oblique lateral stripe of lilac and white, similar to those in the larva of *Sphinx ligustri*, but shorter; horn very short. As to the cause of the dimorphism in the larvæ of this species, Weismann observes (*Studies in the Theory of Descent*, transl. pp. 296, 301) that the larvæ of *E. elpenor*, when young, rest on the leaves, but, when adult, rest by day among the dead branches and leaves of its foodplant, *Epilobium hirsutum*, and on the ground among the tangled leaves and branches if feeding on *E. parvifolium*. The change thus appears to be associated with a change in habit, and it is probable that this (and similarly coloured species with similar habits) first acquired the habit of concealing itself by day on the ground and among dead herbage, before the original green colour could have been changed into brown by natural selection. The adult larvæ are, therefore, sometimes brown and sometimes green, because the anciently-inherited green has not yet been completely replaced by the newly-acquired brown coloration, some individuals still retaining the old green colour.

DEVELOPMENT OF LARVAL MARKINGS.—*First stadium:* 4mm. in length, of a yellowish-white opalescent colour (directly after hatching), the large and somewhat curved caudal horn being black; so transparent that (under a low magnifying power) the nervous, tracheal and alimentary systems could be beautifully seen. As soon as the larvæ began to feed they became green in consequence of the food appearing through the skin, but the latter also gradually acquired a dark green colour (pl. iv., fig. 17). All the specimens (20) were exactly alike and showed no trace of marking. *Second stadium:* The first ecdysis occurred after 5-6 days. Length of larvæ now 9mm.-10mm., shining green, the horn becoming a little red at the base, while a fine white subdorsal line extended from the horn to the head (fig. 18). The head and legs green; the segmental divisions appear as fine light rings, the entire upper surface of the segments also crossed by fine transverse rings (as also was the case in the 1st stage). At the beginning of the present stage no trace of the eye-spots could be detected, but a few days after it was observed that the white subdorsal line was no longer straight on the 4th and 5th segments, but had curved upwards into two small crescents. The latter soon stood out more strongly, owing to the filling up of their concavities with darker green. These are the first rudiments of the eye-spots (figs. 19 and 30). A very fine white

line now connected the spiracles (infra-spiracular line) and could be traced from the last segment to the head. This line takes no further part in the subsequent development of the markings, but disappears in the following stage. The blood-red colour of the base of the black caudal horn is retained till the 5th stage, and then also disappears. Before the second moult, which occurs after another period of 5-6 days, the larvæ, which were about 1·3cm. in length, had assumed their characteristic, tapering, slug-like form. It was not observed that the larva at this stage possessed the power of withdrawing the three foremost segments into the two succeeding ones, as is so frequently to be observed in the adults, neither were these two segments so strikingly enlarged as they are at a later period. *Third stadium*: After the second ecdysis the marking and colouring only undergo change with respect to the eye-spots. The concavities of the crescent-shaped portions of the subdorsal line become black, the remainder of this line at the same time losing much of its whiteness, and thus becoming less distinct, while the crescents assume the appearance of small eye-spots (fig. 20). During this stage the curved crescent-formed portions become prepared for complete separation from the remainder of the subdorsal line, and, just before the third moult, the eye-spots become sharply defined both in front and behind, whilst the black ground-colour curves upwards, and the white spots gradually become lenticular and commence to enlarge (fig. 21). *Fourth stadium:* The third moult takes place after another interval of 5-6 days, the eye-spots then becoming very prominent. The white nucleus of the first spot is kidney-shaped, and that of the hind spot egg-shaped, whilst the black ground-colour extends as a slender border upwards along the sides of the spots, but does not completely surround them till towards the end of the present stage (fig. 21). The central portion of the white spots at the same time becomes of a peculiar violet-brown colour, inclining to yellow above, the peripheral region alone remaining pure white. Of the subdorsal line, only traces are now to be recognised, and these are retained, with almost unchanged intensity, sometimes into the last stage, remaining with the greatest persistence on the three front and on the penultimate segments, whilst on those containing the eye-spots, *i.e.*, the 4th and 5th, not a trace remains. At the present stage, the peculiar mingling of colours becomes apparent over the whole of the upper surface, the green is no longer uniform, but a mixture of short and gently sinuous, dark green striations on a lighter ground, now appear. On the sides of the caterpillar, these stripes, which are at first indistinct but become more strongly pronounced in the next stage, are arranged obliquely on the spiracles, with the lower portions directed forwards. *Fifth stadium:* The 4th moult occurs 7-8 days after the 3rd, the larva being 4cm.-5cm. in length. Whilst all the specimens hitherto observed were, with one exception, light green, they now mostly changed their colour and became dark brown. In one case only did the brown colour appear in the previous (4th) stage. The striations previously mentioned appear as dull and interrupted dirty yellow streaks, the same dirty yellow colour showing itself continuously on the sides of the front four segments. Of the subdorsal line, only a distinct trace is now to be seen on the 11th

and on the front three segments, whilst on the 3rd segment the formation of another eye-spot commences to be plainly perceptible by a local deposition of black (fig. 23). This third spot does not, however, become completely developed, either in this or in the last stage, but the subdorsal line remains continuous on the three front segments. Among other changes at this stage, there occurs a considerable shortening of the caudal horn, which, at the same time, loses its beautiful black and red colours and becomes brownish. The two large eye-spots have now nearly attained complete development. The kidney-shaped white spot has become entirely surrounded by black, and, on the brown, red, and yellow tints present in this spot during the last stage, a nearly black spot has been developed—the pupil of the eye * (fig. 33). In this 5th stage the larva attains a length of 6cm., after which the 5th moult takes place, the larva becoming ready for pupation in the 6th stage. No striking changes of colouring or marking occur after the present stage, but only certain unimportant alterations, which are, however, of the greatest theoretical interest. *Sixth stadium* †: In this stage the eye-like appearance of the spots on the front segments becomes still more distinct than in the 5th stage; at the same time these spots repeat themselves on all the other segments, from the 6th to the 11th, although certainly without pupils, and appearing only as diffused deep black spots, of the morphological significance of which, however, there cannot be the least doubt. They are situated in precisely the same positions on the 6-11 segments as those on the 4th and 5th—near the front, and above and below the subdorsal line. A feeble indication of the latter can often be recognised (fig. 23). In all dark brown specimens the repeated spots can only be detected in a favourable light and after acquiring an intimate knowledge of the caterpillar, but, in light brown and green specimens, they appear very sharply defined. There is one other new character never observed at an earlier period than the 6th stage—*viz.*, the small dots which appear in pairs near the posterior edge of segments 5-11. These dots cannot have been developed from the subdorsal line, as they are situated higher than the latter. Their colour varies according to the ground-colour of the caterpillar, but it is always lighter, being light green in green specimens, dull yellow in those that are light brown, and grey in the blackish-brown caterpillars. These "dorsal spots" are chiefly of interest because they are present in the larva of *Theretra porcellus*, in which species they appear one stage earlier than in *Eumorpha elpenor* (Weismann, *Studies in the Theory of Descent*, transl. pp. 177 *et seq.*).

Comparison of adult larvæ of Eumorpha elpenor and Theretra porcellus.—[The larva of *E. elpenor* is the younger, so that the larvæ are almost equal as regards size. Both larvæ are of the dusky form.] *General coloration:* The larva of *E. elpenor* is of a more inky hue than that of *T. porcellus*, which

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* In order to establish a definite terminology for the different portions of the eye-spot, the pupil is designated the "nucleus," the light ground on which the pupil stands the "mirror," and the black ground which surrounds the mirror is termed the "ground-area."

† We know of no other lepidopterist who has observed a 6th stadium in the larva of this species. The 5th stadium is by all considered to be the last. Weismann's experience must have been quite unusual.

is only a greyish- or smoky-green when it is examined closely; the general effect, however, is to give it an earthy look at a little distance; both have the darker tessellated shading, but in *T. porcellus* there are no velvety-black subdorsal patches, nor is the dark shading round the ocellated spots so intensely black as in *E. elpenor*. *Spiracles*: The spiracles of *T. porcellus* are pure white, those of *E. elpenor* have a dusky band across the centre. *Ocellated spots:* The ocellated spots are quite different; those of *E. elpenor* consist of a rounded lunule, or a bent and round-ended oblong of purple-tinted white, deepening at centre and back to greenish-sepia, the whole giving a blue effect, the spot being situated at the upper edge of a large, roughly circular, velvety-black spot. Those of *T. porcellus* are less striking; the area of the black is greatly reduced by the central spot being broadened into a rounded trapezoid of pearly-white, having, in its centre, a broad oval of dull pink that shades off centrally into a narrow oval of dull smoky-yellow. As ocellated spots, those of *T. porcellus* are possibly the more correctly developed in plan and shading, but their dulness probably renders them less effective in their startling appearance than the more vivid ones of *E. elpenor*. *Structural differences:* There seems little, if any, difference beyond the fact that there is a tolerably well-developed caudal horn in *E. elpenor*, which is absent in *T. porcellus*, although, curiously, the white tip to the horn of the former finds its analogue in a white spot at the apex of the low elevation that replaces the horn in *T. porcellus*. The larva of *T. porcellus* tapers rather more towards the anal end, as though the 8th abdominal segment had dwindled slightly with the degeneration of the horn. In both species the abdominal subsegments appear to be 6 in number, the 1st being equal to the 3 or even 4 following ones in size. (This would make 8 subsegments to each segment were the 1st counted as 3, as is possibly structurally the case.) *Habit:* Both larvæ have a similar slow but jerky method of moving and crawling. (Bacot. July 28th, 1901).

Cocoon.—The larva spins a very slight cocoon among the rubbish below the foodplant (Ransom); the puparium is very loosely spun, composed of leaves and silk (Watkins); makes a slight cocoon under moss, grass or moss being interwoven with the silk (Lambillion); spins an open irregular but strong network of dirty-whitish silk on the surface of the soil, fastening in pieces of earth, dry leaves, &c. (Hellins). Perkins notes (*Ent. Wk. Int.*, 1859, p. 3) finding puparia beneath pinks in a garden at Wotton-under-Edge, larvæ having been found on fuchsias in the same border the previous summer.

Pupa.—This form is characteristically Eumorphid, fairly cylindrical, *i.e.*, not specially flattened; labrum anterior, a distinct keel to anterior 6mm. of maxilla, convexity of eye directed a few degrees ventrally of directly forward. Thickest part 4th and 5th abdominal segments, thinning forwards and with some little flattening in front about end of 1st legs and antennæ (made more conspicuous by the maxillary keeling). The detailed dimensions of an apparently average specimen (♀) are:—

MEASUREMENTS AT	DISTANCE FROM ANTERIOR EXTREMITY.	TRANSVERSE DIAMETER AT	ANTERO-POSTERIOR DIAMETER AT
Eye-spines	1·0mm.	5·3mm.	5·0mm.
Posterior border 1st thoracic segment	4·0 ,,	8·0 ,,	8·3 ,,
Widest part of mesothorax..	7·0 ,,	9·3 ,,	8·8 ,,
End of 1st leg and antenna (1st abdominal) ..	12·0 ,,	10·0 ,,	10·0 ,,
End of 2nd leg (3rd abdominal)	16·0 ,,	10·6 ,,	10·6 ,,
Widest part (4th abdominal)	19·5 ,,	11·2 ,,	11·0 ,,
End of 4th abdominal	22·0 ,,	11·0 ,,	11·0 ,,
Across spines (5th abdominal)	25·0 ,,	11·4 ,,	11·0 ,,
Across spines (6th abdominal)	28·0 ,,	11·0 ,,	10·3 ,,
Across spines (7th abdominal)	31·5 ,,	9·0 ,,	8·8 ,,
Middle 8th abdominal	34·0 ,,	7·0 ,,	6·6 ,,
Base terminal spine	37·0 ,,	3·7 ,,	1·3 ,,
End of spine=Total length	39·5 ,,		

At the extreme front is a rough prominence, nearly as a transverse ridge 2mm., transversely by ·6mm., so rough that it is not easy to say whether it is labrum and mandibles, or belongs to the clypeus and epicranium, it has a central portion and a more pronounced point at each end. Further out and immediately in front of the eyes is a square prominence, ending in a rounded tubercle with one or two subsidiary ones (called eye-spines above); besides the maxillary keel, the 1st tibiæ present a prominent fulness in front. The antennæ and 1st legs terminate at about same level, the 2nd legs are separated from head by the 1st ones touching about 1mm. of the antennæ. Wings and maxillæ terminate together at margin of 4th segment (abdominal). The 5th, 6th and 7th abdominal segments possess each a circle of spines, which is nearly complete on 7th, but wanting over ventral 4th of segment on 5th and 6th. They are not referable to any subsegment (*i.e.*, not obviously), they are quite to the front of the segment dorsally, are less so laterally when they lie behind the spiracles and then again pass a little more forwards. In the movements of the pupa, they just touch the margin of the segment in front, in extreme flexion of the pupa in any direction. Dorsally, they are smallest, but most numerous in several irregular rows, they are largest half-way from this to spiracles, whence there is no more than one row, but so irregularly placed as to quite admit of being described as isolated spines belonging to two or more rows. They are black, conical, sharp-pointed, with a curve backwards. They stand on the anterior slope of a ridge most marked where they are largest. The largest are perhaps ·2mm. in length, by ·15mm. wide at base. These spines, with the head tubercles, suggest a habit of leaving the puparium for emergence. The anterior spiracle is very obvious but has no lips or flanges of special structure, the others are narrow oval areas, with a central slit, which has raised margins and is a little wider at either end, the areas are surrounded by the ordinary wrinkling which takes, however, the form of fine concentric rings round them. When mounted as a transparent object, however, the anterior spiracle is seen to have a thickened anterior lip with many fine hairs, the posterior to be a flattened plate, closely

beset with minute spicules, the true spiracle is at some distance within this. The anal spine is very large and formidable, its base occupies the whole dorsal half of the 10th abdominal segment, nearly 3·5mm. broad and over 1·0mm. thick, seen from above it is triangular, but not quite regularly; for the first 1·3mm. the sides approach each other slightly, then, curving in, proceed to a point; the length is 3·0mm., really it is more, as when seen sideways, the dorsum is seen to be longitudinal for 2·0mm. and then to bend down at an angle of 120° or thereabouts for 2·5mm., whilst the venter is regularly curved; it ends in a very fine polished point, the extremity of which is, however, minutely bifid; beneath, it has a central ridge and two side hollows, and there is a deep grooved recess between its base and the anal eminences; it is black and covered with closely-set rather deep pits, the ridges between which preserve much of the character of wrinkling. The subsegmentation is obscure, except on dorsum of the 2nd and 3rd abdominal segments, where there is a broader anterior subsegment, and 4 narrower subsegments behind it; traces of these may be seen on the other segments. Behind, and ventral to the spiracles in abdominal segments 5 and 6, may be seen, halfway between the spines and the posterior margin of the segment, the broader wrinkle, as of a wave flowing from the front backwards, since the level is lower behind it than in front, which marks off the intersegmental subsegment, which is not otherwise very obvious. The scars of prolegs may be quite absent, or may be darker (more chitinised), projecting, smooth, and altering the lines of wrinkling. The normal arrangement seems to be a little extra dark pigment, with a slight elevation and hollow behind it, but no interference with the transverse lines of the wrinkling. The horn scar is equally variable. In one specimen, a little extra pigment is all that denotes it, in another it is a little raised polished circle of darker (more chitinised) colour, surrounded by a ring of minute pits, with the fine wrinkling radiating from it into the general surface, but actually dominating the lines on the whole dorsum of the segment. There is also a very definite hollow behind the raised spot. The general sculpture or wrinkling is exceedingly difficult to describe in all these pupæ. I am not sure that the attempt is not hopeless. It affords definite differences between many different species of these pupæ, and yet description will hardly show anything that is not common to many of them. It is, perhaps, hardly mere sculpturing that the middle ventral line of abdominal segments 5 and 6 shows in most specimens as a longitudinal dark mark, which, in some specimens, has a depressed groove added. The prothorax appears to have a median suture which sometimes is and sometimes is not functional on dehiscence; there is none in mesothorax. The head is tuberculated, rather than wrinkled, and there is almost a definite pattern within the circle of the glazed eye; the antennæ have a central line and transverse impressions on either side (marking segments). The segments are separated by a fine double line, and there is indicated a line across each segment, the true wrinkling is extremely minute and secondary to these. The ridge of the maxillæ has a depressed line separating its two sides, and has various irregular wrinklings, on the whole transverse. The

legs are roughly tuberculated, perhaps, rather than wrinkled. The thorax is finely wrinkled in a "cerebral convolution" sort of pattern, without special features, except to be coarser at the wing-bases. The wings have coarse transverse wrinkling along the costa, finer and longitudinal at the hindmargin, varying in some specimens to nearly smooth; the nervures are visible, more so at a little distance as paler lines than on closer inspection. The abdominal wrinklings down to the 6th segment are of the cerebral convolution pattern, except that they are arranged to be practically transverse. On the 5th and 6th abdominals they are much coarser in front than behind the spinous ridge, with a somewhat intermediate condition on the 7th, on the 8th and 9th the sculpture is largely pitting. The colour is terracotta, with a very varying amount of black. The thorax and wings, a dorsal line, and the subdorsal region are always dark, sometimes quite black. Individuals vary so that one would expect as rare varieties to see one pure terracotta or pure black. On the thorax the sulci of the wrinklings are black, even when the ridges are pale; the same is the case with the wings and these often have black spots in rows down the nervures. On the abdomen the black especially affects the hair-spots, but is also more widely distributed. Viewed as a transparent object, the shell structure is very elaborate. The sulci in thorax and wings are marked as dark dendrites. At the wing-bases are a considerable group, on each side on meso- and metathorax, of fine hairs in minute circles or in chitinous points; these are less common dorsally. The hindwing, by the way, just falls short of the spiracle of the 3rd abdominal before being lost under forewing. The minute hair-points become more numerous on the abdominal segments and only fail on the absolute dorsal line. No definite arrangement of them is detected. Passing backwards, the hairs and hair-points become more numerous; when hairs are absent the hair-points are present as dark spots at the intersections of the dendritic lines of the sulci. On the final segments the pits are these same points enlarged into coin-like hollows, with either a minute hair or a hair-point in the centre. The spines on the abdominal ridges are seen to be a special development of these hair-points. Seen under the microscope, some of these are solid projections rising from the surface, not unlike, in colour and shape, the anal spine of the pupa. Some are then found with a deep pit under them, or rather behind them; then, in the neighbourhood of these, hair-points with hairs, but with the forward margin of the surrounding circle of chitin raised into a ridge with central point, clearly the same structure as the spine. In the course of examining the pupæ, bits of fine scale became detached, and it is found that the pupa is covered by a fine scale, as in *Mimas tiliae* (*anteà*, vol. iii., p. 412), most often observable on the thorax, where it is consolidated with the ridges, but passes across the valley of the wrinkling, but, when looked for, it is seen to cover the whole pupa, at least in some specimens. The anal scar is a longitudinal depression with a raised, rather broad, lip surrounding it, with parallel impressed lines. The lips pass round the posterior end of the depression and overhang the cavity at the base of the anal spike. Anteriorly they rather fade out into the general surface. There is considerable

difference in their disposition, sometimes the lips with the central line as depression occupy a circular area, more often it is narrower, *i.e.*, elliptical, and sometimes, by the sides being nearly parallel, it is rather quadrangular. The small angular portions of the 10th segment not occupied by the scar and spike are strongly pitted, but usually without special feature; rarely, close to the posterior angle of the anal scar, there is an irregularity that may be the scar of the larval claspers. The male tubercles are full and rounded, occupy an exactly circular area, with the median crevice between them; this is a little wider posteriorly. Though in the middle of abdominal segment 9, these male tubercles have the appearance of belonging to 10, as the posterior border of 9 is wanting opposite them, *i.e.*, appears to bend up to them, and may more easily pass round them in front than behind. Precisely similarly the segmental divisions are wanting in the same parts in the female pupa between 8, 9, and 10; 9 presents a few wrinkles, which pass back to the anal scar, and the margin of 8—9 passes forwards to the posterior pore. This is very similar to the male pore, but on a much smaller scale; in front of this is, less marked but quite distinct, another longitudinal impression; the area on 8 occupied by these two pores and their accessories is a square with its diagonals longitudinal and transverse, and from its lateral angles a line passes outwards and fades into the posterior margin of the segment (Chapman).

Pupal habits.—The pupa of *E. elpenor* is remarkable in that it is able to work its way out of its cocoon before emergence in the same way as does the pupa of *Dimorpha versicolora*. This is effected by means of the spines already described (*antea*, p. 78) as existing along certain of the abdominal segments. Bacot notes that he had larvæ, in 1895, that pupated in a flower-pot filled with moss, and formed long and rather narrow cocoons by spinning the moss stems together with a small amount of silk. These cocoons were all vertical, or nearly so, and were from half-an-inch to an inch longer than the pupa, the top being usually left open; in the spring the pupæ were observed to move up and down in their cocoons, and one, in particular, used to push itself half-way out on sunny days, going down again in cold and dull weather, and it was half-way out of its cocoon when the moth was disclosed; some moths, however, emerged from pupæ that had their heads only protruding, while, in other instances, no movement on the part of the pupa had apparently been made before emergence. Ransom observes that, about a month before emerging, some pupæ work their way out of the cocoons and travel several inches away from the cocoon; the movement is accomplished by means of strong spines on the abdominal segments; the abdomen is moved from side to side, and the spines, catching hold of any substance with which they come in contact, enable the pupa to progress. Russell notes that as early as May 14th, the pupæ (which remained in the moss in which the larvæ had pupated) prepared for emergence. They raised themselves on end, and, in many instances, stood out of the moss practically upright, although about one-third of the pupæ appeared to make no movement at all. A note in the *Ent. Wk. Int.*, vii., p. 109, states that a pupa worked itself out of its loose cocoon, and lay quite bare on the moss for 5 or 7 weeks before

the emergence of the perfect insect. Bacot observes *(in litt.)* that he has immersed pupæ of this species in water for periods of a few hours up to 23 days, and that they have all survived.

FOODPLANTS.—*Epilobium angustifolium*, *Impatiens*, *Vitis*, *Convolvulus* (Linné), *Galium palustre*, *Epilobium hirsutum* (Buckler), *Menyanthes trifoliata* (Huene), *Galium mollugo*, *Fuchsia*, vine (Hellins), variegated holly, *Fuchsia fulgens* (Hodge), *Galium verum* (Riding), *Epilobium palustre* (Lambillion), *Impatiens noli-me-tangere*, *Circaea lutetiana* (Crewe), *Vitis vinifera* (Calberla), *Rubia tinctorum* (Snellen), *Lythrum salicaria* (Krieghoff), *Epilobium parviflorum* (Weismann), *Lythrum purpureum* (Poulton), *Circaea intermedia*, *Ampelopsis hederacea* (Rössler), *A. quinquefolia* (Garbowski), *Impatiens parviflora*, *Balsamina repens*, *Lonicera (teste* Bartel), lettuce (Vaughan, *Ent.*, xxxiv., p. 100), apple (Thornewill). Bacot observes: "The larvæ eat *Fuchsia* well in captivity; in nature (in the Lea valley) they appear to commence on *Galium palustre*, and after they have finished this they attack the *Epilobium*, on the top of a tall plant of which they are sometimes very conspicuous." Ransom notes: "The larvæ eat *Galium palustre* and various species of *Epilobium*, but *E. hirsutum* much less frequently than the other species." Russell writes: "The larvæ eat fuchsia greedily, but some I had did not fancy one plant that had reddish-coloured leaves." At the meeting of the Ent. Soc. of London, November 19th, 1902, Mr. Goss stated that in August, 1898 and 1899. he collected a number of larvæ of *Eumorpha elpenor* feeding on *Impatiens noli-me-tangere*, that, when this was exhausted, he offered them *Epilobium hirsutum*, *Fuchsia*, *Galium mollugo*, and *G. aparine*. The larvæ refused to eat any of them, and many of the larvæ (nearly three dozen) died of starvation before a fresh supply of *Impatiens* could be obtained.

PARASITES.—*Amblyteles proteus*, Christ (Bignell), *Amblyteles fusorius*, Linn. (Brischke), *Ichneumon privenis* (Harris).

HABITS.—The imago usually emerges in the morning about 9 a.m. (Hewett). Both sexes fly to flowers at dusk, flight not lasting long (Rühl), and they may then be sometimes taken in large numbers. They affect the flowers of *Saponaria*, *Lonicera*, *Echium*, *Petunia*, &c., in Germany (Bartel), flowers of *Syringa* and *Lonicera caprifolium* in the Baltic provinces (Nolcken), but are attracted by many other flowers—Turk's-cap lily at Armagh (Johnson), rhododendron, swarming in scores at one small bush at Dinas Mawddwy (Tetley), also abundant at the same plant at Lissan (Greer), garden-rocket (Ash), *Galium* (Sich), *Iris pseudacorus* (Barrett), *Cerasus lusitanica* (Oldham), at violas at Bushey Heath (Barraud), at *Aconitum napellus*, abundant at St. Clerans (Lawless), white pinks and valerian at Sulby (Clarke), different varieties of garden *Iris* are particularly attractive at Clevedon (Mason), whilst honeysuckle is repeatedly noted from various localities. The moth is also attracted by sugar. We shall never forget one dark evening in June, 1874, at Cuxton, when rain came on at dusk, directly after the sugar had been put on the trees; Noctuids swarmed, but the appearance of several splendid imagines of *Eumorpha elpenor*, drinking steadily at the sugar on quivering wing, proved the excitement of the evening. Comes freely to sugar at Sulby from about June 9th (Clarke), buzzing at the sugar at Barnwell Wold, also at Abbott's Wood in

1892 (Porritt), at sugar at Gravesend (Button), in Wicken Fen (Musham), in the Wye Valley (Vaughan), at York (Wilson), at Llanrwst (Pearson), at Ranworth (Harmer), hovering at the sugar in south Devon (Prideaux), a fine ♂ at sugar, July 1st, 1897, at Benfleet, quite settled on it and not flying round (James), June 24th, 1899, and July 1st, 1900, at Bude, at sugared *Iris*, and on June 12th, 1900, at Wicken, at a sugared treetrunk (Kaye), Hervey notes 4 specimens at sugar at Glastonbury, June 22nd, 1875, three hovering at one tree, and taken by one sweep of the net; they arrived comparatively early in the evening, before the lamp was lighted to examine the sugar. Burrows observed one hovering at sugar, June 19th, 1896, at Rainham; the light was kept steadily on the insect, whilst a larger box was fetched; it took no notice of the light, but went on drinking. Trimoulet also records the insect at sugar in the Gironde dept. The imagines are also attracted to light—at the electric lights at Bern (Hiltbold), at Pörtschach (Wägner), most abundant on July 3rd-4th, 1898, from 9.15 p.m.—10.20 p.m., at Aigle, at the electric lights (Lowe), also at electric light at Eastbourne (Dewey), at Ipswich (Morley), at Chester (Dobie), at light at Taunton (Farrant), at Paul (Daws), at Erith (Fenn), at Winchester (Shepheard-Walwyn), &c. Smith notes a ♀ captured by a friend at Exeter, carried to Burton alive in a box in pocket, and states that, while waiting near Cheltenham, a ♂ settled on him (*Ent.*, xxix., p. 124). Time of day and other details are altogether wanting.

Habitat.—The imagines visit gardens, roadsides, woodsides, &c., attracted no doubt by the flowers, and their larvæ are occasionally found in such localities, but fens, ditchsides, river-banks, streamsides, pondsides, and similar localities are their favourite haunts. The larvæ are sometimes abundant on all the ditchsides between Sandwich and Deal (Tutt), ditchsides at Folkestone (Byrne), on the banks of a pond at Oxton (Studd), along the banks of the Stour near Ashford and Wye (Theobald), on the banks of ditches and by the riverside near Sudbury (Ransom), along the banks of streams and ditches at Maidstone (Gandy), abundant in the water-meadows at Newbury (Hopson). Thornewill records finding a larva in a garden at Burton on apple; Perkins finds the species sometimes common in gardens at Wotton-under-Edge, and Calberla states that the larvæ are abundant in the vineyards of the Roman Campagna.

Times of appearance.—In the British Islands the species is single-brooded, occurring generally in late May and June (extending in late seasons into July), whilst the appearance of autumnal examples is very occasional. We have only noted the following records, *viz.*, reared a second brood through August, 1859, at Lancaster (Taylor). Several larvæ obtained in July at Oxford, pupated in due course, two pupæ producing imagines on August 5th, 1868 (Matthews), September 12th, 1878, an imago at Taunton (Parish), August 13th, 1879, at light. at Erith (Fenn), a second-brood ♀ example emerged September 15th, 1900, at Sudbury, from a pupa that was in the pupal stage a very short time and which was of a very pale colour (Ransom). On the continent complete or partial double-broods are common. Thus we find—end of May and commencement of

August at Lüneburg (Machleidt), June and August-September at Crefeld (Rothke), May-June and August at Leipzig (*teste* Bartel), May-June and August, common, in Baden (Reutti), May and August at Wiesbaden (Rössler), May-June, but more abundantly July-August at Dessau (Rössler), May-June, but occasional single specimens under favourable conditions in autumn at Ratisbon (Schmid), May-June in Inn Valleys, but imago again July 20th, 1896, at Riesenhof (Himsl), May-June, and again in August, at Epiries (Husz), May-June and August-September in Budapest (*teste* Bartel), Fritsch gives dates for Austro-Hungary from April 18th (at Pressburg) and May 1st up to July 10th, with two doubtfully second-brood records on July 13th and August 3rd, and two evident second-brood ones, August 26th and September 12th, all from Salzburg. Double-brooded in Roumania, end of May and August-September, very common from August 25th to September 19th, at Valeni (Caradja), May-June, and very rarely in August in the Haute-Garonne (Caradja), May-June, and again in August, at Mantes (*teste* Speyer), common from May 15th to September 30th, but especially in July in the Indre dept. (Martin), June-July and again in September at Florence (Fiori), May and again in July, double-brooded, in the Roman Campagna (Calberla), May and July-August at Aix-les-Bains (Agassiz), &c. Single broods only have been recorded from the following—May in the Kuldja district (Alphéraky), June in Wetterau, also in southwest Siberia (*teste* Bartel), May-June at Kaschau, Raab, Draga, near Fiume, &c. (Fritsch), May-June at Biedenkopf (Rühl), Eutin, Brunswick, Wernigerode, Halle, Thuringia, Augsburg, Schwerin, Bremen, Cassel, &c. (*teste* Bartel), May-June at Sarepta (Eversmann), May-June in Switzerland (Frey), at light from June 14th, 1893, at Berne (Hiltbold), May-June in all the provinces of the Netherlands (Snellen), May-July in the Baltic provinces (Nolcken), May-July at Carlsruhe (Reutti), &c. The following records show little as to whether there are two broods or not in the respective districts—May 8th, 1899, at Chifu (Fletcher), June-July, very common in Lombardy (*teste* Bartel), May-July in Sicily (Minà-Palumbo), July 16th, 1897, at Solka, in Bukowina (Hormuzaki), July 25th, 1879, at Wiesbaden (Sich), July 3rd and 4th, 1898, at Aigle (Lowe). The time of its appearance may vary locally in Britain, *e.g.*, Woodforde notes it as appearing later at Market Drayton than in North Wales (June 2nd-July 15th at Market Drayton). The following are the actual dates of appearance that have accumulated: June 1st-15th, 1858, at dusk near Gloucester (Guise), June 21st, 1858, June 3rd, 1861, emerged May 28th, 1865, at Worcester (Edmunds), June 22nd, 1858, seven at one time at a rhododendron at Tinahely (Bristow), June 7th, 1859, and following days at Oundle (Whall), June 9th-22nd, 1861, June 2nd-5th, 1889, May 24th, 1893, all bred from larvæ from Deal (Fenn), July 8th, 1866, at Chertsey (A. H. Clarke), June 12th, 1868, at Northleach (Todd), June 20th, 1868, at Cirencester (Harman), June 22nd, 1868, at Gravesend (Button), bred June 11th, 1870, from larva found at Kingsmill, August 26th, 1869 (Watkins), bred June 1st, 1871, June 11th-20th, 1876, June 7th-8th, 1900, at Oxton (Studd), June 6th, 1876, at Goring, June 11th, 1877, netted in a willow-bed at Burghfield, June 16th, 1881,

netted in garden at Reading, June 18th, 1890, at Caversham (Holland), June 26th, 1879, at Rugby (Wilson), June 14th-26th, 1880, at Wicken, June 1st-9th, 1881, at Barnwell Wold, June 27th-29th 1892, at Abbott's Wood (Porritt), June 21st, 1881, at Ranworth (Harmer), July 12th, 1882, at Teddington, July 14th, 1898, June 19th, 1899, at Lynmouth (T. Briggs), pretty abundant June, 1885, at St. Ives (Norris), June 28th, 1886, June 12th, 1887, at Brentwood, June 10th, 1893, June 19th, 1896, at sugar at Rainham, from June 11th-15th, 1901, at Mucking (Burrows), August 28th, 1886, fullfed larvæ at Deal, imagines emerged June 21st, 1887, three nearly fullfed larvæ on one clump of great willow-herb at Rickmansworth on August 12th, 1887, imagines emerged June, 1888, larva at Broxbourne on August 18th, 1887, imago emerged June, 1888, fine ♂ July 1st, 1895, at Benfleet, August 1st and 25th, 1899, 2 larvæ at Mundesley, 1 ichneumoned, the other produced an imago June 30th, 1900 (James), June 12th, 1887, at Brentwood, June 25th, 1896, at Panton (Raynor), July 6th, 1888, in New Forest (J. A. Clark), beginning of July, 1888, in garden at Groombridge (Blaber), July 12th, 1888 (late year), several emerged although kept in a summer-house at Bristol (Griffiths), June 18th, 1890, at Howth (Hart), June 19th, 1890, at Llanrwst (Pearson), June 11th-18th, 1890, at Swansea (Robertson), June 10th, 1891, June 27th-30th, 1892, at Mansfield, July 12th, 1899, June 2nd, 1900, at Paul, June 10th, 1900, at Redhouse Downs (Daws), earliest imago on June 6th, in 1892, at Charlton Kings (Brooke), June 11th, 1892, at Freshwater (Hodges), captured at Polegate on June 25th, 1892, bred at Sandown on May 30th, 1895, May 31st, 1896 (Prout), larva August 3rd, 1892, produced an imago May 30th, 1893, at Guildford (Grover), May 20th, 1893, at sugar at Lyndhurst (Tremayne), June 9th, 1893, at Armagh (Johnson), June 15th, 1893, at Instow (Hinchliff), June 1st-18th, 1894, June 12th, 1899, and days following, common at Wishanger, in 1900 not a single specimen was seen during the season (Bingham-Newland), bred from Wicken on May 31st, 1895, bred at Wisbech, June 13th, 1895 (Glenny), June 16th-26th, 1895, June 11th, 1896, at Enniskillen (Allen), May 24th, 1896, in Wyre Forest (Rea), early June, 1896, at Church Stretton (Newnham), imago bred June 3rd, 1896, at Armagh (Johnson), June 26th, 1896, at Chelmsford (Miller), June 26th, 1896, worn imago at Bexley, came to sugar while it was being put on (Bower), June 1897, at Trefriw, June, 1900, at Ballyshannon (Bland), June 15th-21st, 1897, July 2nd, 4th, 9th, 10th, 30th, 1898, at Cambridge (Thornhill), June 5th, 1895, June 7th-13th, 1897, May 21st-June 6th, 1899, also June 9th, 11th, 12th, 15th, 19th, 20th, 21st, 30th, July 2nd, 4th, 7th, 1900, at Sulby (Clarke), June 20th, 1897, at Winster (Cotton), imago ♀ captured at Reading July 12th, 1897, laid ova which hatched, and first imago emerged on June 28th and the last on July 9th, 1898 (Butler), June 10th, 1898, at Dairycoates, near Hull (Holt), imago June 11th, 1898, at Reigate, and July 3rd, 1900, in S. Devon (Prideaux), June 20th, 1898, at Leicester (Dixon), June 20th, 1898, at Enfield (Edelsten), June 26th-30th, 1898, on sandhills between Waxham and Horsey (Cox), July 9th, 1898, at Bushey Heath (Barraud), larvæ on August 15th-16th, 1898, at Fleet, imagines emerged June 6th-16th, 1899 (Russell), June 7th, 1899, at Chester, at light (Arkle), June 14th, 1899, at Prickwillow (Eddrup),

June 18th, 1899, at sugar at Wicken, June 23rd-July 1st, 1900, at Hailsham (Carr), July 7th, 1899, in the Norfolk Broads, July 27th, 1899, at Whitwell (Freeman), [January 9th, 1900, at Brecon, pupa kept indoors (Vaughan), March 1st, May 1st and 2nd, 1900, bred three imagines from pupæ, the larvæ from East Hoathly, 1899 (Sich)], imagines June 3rd, etc., 1900, at Southampton (Moberly), June 30th, 1900, at Bude (Kaye), June 25th, 26th, 28th, 30th, 1900, at Lissan (Greer), July 3rd, 1900, in Cumberland (F. H. Day), emerged July 7th-11th, 1900, from pupæ from Sudbury (Hewett), imago freshly emerged June 10th, 1901, at Helmsley (Archer), June 4th-12th, 1901, June 21st, 1902, and following days, at Selby (Ash), June 22nd-July 10th, 1901, also bred June 1st, 1902, from a larva that pupated September 25th, 1901, at Dorking (Oldaker), June 26th, 1901, imagines bred at Scarborough (Head), June 27th, 1901, an imago at Stanstead Abbot (Image), July 14th, 1901, worn specimen at Glaisdale (Atkinson), July 15th, 1901, at Norwood (Swain), June 15th-24th, 1902, at sugar, in the New Forest (Lawrance), June 18th-July 1st, 1902, in New Forest (Lofthouse), July 16th, 1902, at Sherborne (Douglas).

LOCALITIES.—Generally distributed over eastern, southern, and western England, and also in Ireland, exceedingly rare in the north of England, and scarcely known in Scotland (the records below being chiefly of single specimens). [ABERDEEN: Aberdeen (Jasdowski).] ANTRIM: Belfast, not scarce (Bristow). ARMAGH: Armagh (Johnson). AYR: Lendalfoot (Dunlop), near Ayr (Wilson). BEDFORD: Bedford (Steuart). BERKS: Reading (Reece), Burghfield, Sulham, Bulmershe Park (Holland), Newbury (Hopson). BRECKNOCK: Brecknock, Wye Valley (Vaughan). BUCKS: Buckingham, on banks of Ouse (Slade), Wavendon, near Newport Pagnel, Halton, common (Stainton). CAMBRIDGE: common throughout, especially in the Fen district (Balding), Whittlesford (Thurnall), Prickwillow (Eddrup), Wicken (Carrington), Cambridge (Waters), Wisbech (Oldham). CARMARTHEN: Langharne (Kaye), Carmarthen (Wilson). CARNARVON: Penmaenmawr, Trefriw (Bland), near Deganwy (Gardner), Pwllheli (Johnson), Abersoch (G. O Day), Llanrwst (Pearson), Tan-y-Bwlch (Arkle), Beddgelert (Sich). CAVAN: Farnham (Kane). CHESHIRE: generally distributed throughout (G. O. Day), Malpas (Wolley-Dod), Cuddington, scarce, Oakmere district, abundant (Newstead), Rostherne (Thorpe), Tarporley (Stock), Chester (Dobie), Kenyon, Rixton, Knutsford, Lymm, High Leigh, Withington (Chappell), Wirral (Brockholes), Delamere and east Cheshire (Walker), Bidston Marsh (Gardner), Bromborough, West Kirby (Pierce), Wallasey (Cooke), Birkenhead, very common (Stainton). CLARE: East Clare (Stacpole), Dromoland (O'Brien), Ennis (Brakey). CORK: Ummera Woods, Glandore, Timoleague, Courtmacsherry (Donovan), near Cork, Kinsale, Castlehaven, Glengarriff (Kane). CORNWALL: Lizard (Riding), St. Austell (Hodge), Bude (Kaye), Paul, near Penzance, Redhouse Downs (Daws), Truro (Stainton). CUMBERLAND: Carlisle district (Armstrong), Cockermouth (Robinson), Keswick district, rare (Beadle), Flimby (Mawson), Headsnook (Porter), Lake district (Stainton), Peastree Wood, Cummersdale (Thwaytes), much commoner than *porcellus*—Orton, Silloth, Siddick (F. H. Day). DENBIGH: Chirk (Gardner), Colwyn Bay (G. O. Day). DERBY: Burton district, frequent (Brown), Burton (Thornewill), Shobnall (Harris), Derby (Smallwood and Hill). DEVON: Oxton (Studd), Honiton (Riding), Lynmouth (T. Briggs), Exeter (Smith), Stoke (Harvie), Ilfracombe, Barnstaple (Mathew), Dartmoor (Gummer), S. Devon (Prideaux), Sidmouth (Majendie), Tiverton (Still), Instow (Hinchliff), Plymouth, Teignmouth (Stainton). DONEGAL: Donegal, Bandoran (Kane), Ballyshannon (Bland). DORSET: Sherborne (Douglas), Corfe (Bankes), Blandford (Stainton). DUBLIN: Kingstown, Killiney, Malahide (Kane), Blackrock (Greer), Howth (Hart). DUMFRIES: Dumfries (Lennon). EDINBURGH: Edinburgh (Jenner-Fust), Salisbury Crags (Duncan). ESSEX: Wanstead Flats (Carrington), Maldon (Sampson), Hackney Marshes (Clark), Lea Bridge Road (Henderson), Sudbury district, Henny, Borley (Ransom), Ilford (Adams), Chelmsford (Miller), Benfleet (James), Mucking, Brentwood, Rainham (Burrows), Woodham Mortimer, Woodham Walter, Ulting (Raynor), Epping (Image), Forest Gate (Mera), Leyton (Meldola), Chiugford (Latchford). FERMANAGH: Enniskillen (Allen). FLINT: Overton (Perkins). GALWAY: Galway (Allen), Castle Taylor (Nugent), Ballinasloe (Kane), Clonbrock (Dillon), St. Clerans (Lawless), Connemara, very abundant (Birchall). GLAMORGAN: Swansea, scarce (Robertson).

GLOUCESTER: Northleach (Todd), Bristol (Griffiths), Stonehouse (Nash), near Cheltenham (Smith), Cirencester (Hamm), Charlton Kings (Brooke), Stapleton, scarce (Hudd), Wotton-under-Edge (Perkins), King's Mill, Painswick (Watkins), near Gloucester (Guise), Tewkesbury district, rare (Fox), Clevedon (Mason), Lower Guiting (Stainton). HANTS: Winchester, occasional (Fisher), Gosport (Pearce), Isle of Wight—Freshwater (Mera), Sandown (Prout), New Forest (J. A. Clark), Ringwood (Fowler), Fleet (Russell), Romsey (Buckell), Basingstoke (Holdaway), Southampton (Moberly), Wishanger, Headley (Bingham-Newland), Lyndhurst (Rawnsley), Shirley (Fountain). HEREFORD; Leominster (Hutchinson), Tarrington (Wood). HERTS: Hertford (Stephens), Letchworth (Knapp), Hitchin (Griffith), Stanstead Abbot (Image), Bushey Heath (Barraud), Rickmansworth, Broxbourne (James), Cheshunt (Robbins), Waltham Cross (Bowles). HUNTS: St. Ives (Norris). ISLE OF MAN: Sulby, common (Clarke), Orrysdale (Crellen). KENT: Chattenden, not common (Chaney), Cuxton (Tutt), Appledore (Heitland), Ramsgate (Buckmaster), Folkestone (Byrne), Gravesend (Button), Deal (Hardiug), Sundridge (Hamond), Chatham (Arkwright), Maidstone (Gandy), Bexley (Bower), Catford, Erith, Dartford (Fenn), on the banks of Stour, near Ashford, and at Wye (Theobald), Tenterden (Stainton), Tuubridge Wells (Dallas-Beeching). KERRY: Caragh (Raynor), Killarney, Sneem (Kane), Garinish Island, very abundant (Lawless). LANARK: Clyde district (F. B. White). LANCS: generally distributed throughout the southwest of county, less frequent as one goes north (Ellis), Hightown (Moss), Winster (Cotton), Lancaster (Taylor), Manchester, Chorley (Buxton), Burnley (Clutten), Carnforth (Murray), Preston, common (Stainton). LEICESTER: Loughborough (Moss), Leicester (Rowley), Loseby (Browne), Syston (Bouskell). Gumley (Matthews). LEITRIM: Mohill (Kane). LIMERICK: near Limerick (Kane). LINCOLN: Lincoln district, common (Carr), northeast Lincoln (Ash), Great Grimsby (Dawson), Panton (Raynor), Cleethorpes (Porritt), Wyberton (Lane-Claypon), Newball, Legsby (Fowler). MAYO: Crossmolina (Kane). MERIONETH: Dinas Mawddwy, abundant (Tetley). MIDDLESEX: Clapton, formerly (Bacot), Chiswick (Sich), Stamford Hill (Sheldon), Tottenham (Bayne), Pouders End (Lane), Ealing (Fenton), Highgate Woods (Southey), Hammersmith (Taylor), Lea Marshes (Fenn), Harrow district, Kingsbury (Bond), "Ducker" (Rhoades-Smith), Teddington (T. Briggs), Tottenham Marshes (Henderson). MONAGHAN: Drumreaske (Kane). MONMOUTH: Llandogo (Nesbitt). NORFOLK: Horning (Sheldon), Mundesley (James), Ranworth (Winter), Aylsham, Whitwell, Norfolk Broads (Freeman), Stalham (Edelsten), near Norwich (Moss), Waxham, Horsey (Cox). NORTHAMPTON: Barnwell Wold (Porritt), Oundle (Whall), Peterborough (Morley). NORTHUMBERLAND: 2 records only (Robson) Newcastle (Wailes), Twizell (Selby). NOTTINGHAM: Mansfield (Brameld), Sherwood Forest (Pickard), Chilwell (Pearson). OXFORD: Oxford (Matthews), Adderbury (T. Briggs), Thame (Fenn), Caversham, near Reading, Goring, Henley (Holland), Woodstock (Beales), banks of Isis and Cherwell (Poulton). PEMBROKE: Pembroke (Barrett). PERTH: Earn, Gowrie and Athole districts (F. B. White), Sidlaws, Alyth, Abernethy (Guthrie). RADNOR: Wye Valley, below Builth (Vaughan). RENFREW: Clyde district (F. B. White). ROSCOMMON: Mote Park (Kane). RUTLAND: Uppingham (Bell). SHROPSHIRE: Market Drayton, sparingly (Woodforde), Wyre Forest (Rea), Church Stretton (Newnham), Shrewsbury (Stainton). SLIGO: Markree Castle, Lough Gill, Hollybrook (Kane), Knocknarea (Russ). SOMERSET: Taunton (Farrant), Brislington (Ficklin), Bath (Ross), Wells (Livett), Cary Hill (Macmillan), Clevedon (Mason), Glastonbury (Hervey). STAFFORD: general in district, Cheadle (Blagg), Burton-on-Trent dist. (Brown), Market Drayton dist., not uncommon, Betton (Woodforde), North Stafford, not uncommon, Madeley (Daltry). SUFFOLK: somewhat common (Crewe), banks of Stour, Cavendish (Wilson), Bentley (Burrows), Sudbury dist. (Ransom), Ipswich (Morley), Brandon (Bower), Stowmarket (Stainton). SURREY: Guildford (Grover), Norwood (Swain), Wimbledon Common (Tarbat), Weybridge (Goss), Chertsey (A. H. Clarke), Reigate (Prideaux), Dorking district (Oldaker), Camberley (Watson), Frensham district (Bingham-Newland). SUSSEX: not uncommon—Brighton, Haywards Heath, Glynde, Eastbourue (Jenner), Abbotts Wood (Porritt), Polegate (Prout), Lewes (Nicholsou), Weald district, Cuckfield, Blunts Wood (Merrifield), Rye (Henderson), Balcombe (Image), Boguor, rare (Lloyd), Henfield, Chichester (Fletcher), Hastings district, rare (Bloomfield), East Hoathly (Sich), Groombridge (Blaber). TYRONE: Tullylagan, Lissan, Dungannon (Greer), Favour Royal, abundant (Kane). WATERFORD: Portlaw (Flemyng), Cappagh (Ussher), Waterford, Dunmore, Tramore (Kane). WARWICK: Rugby (Wilson), Birmingham (Imms),

Marstou Green (Stone). WESTMEATH: Mullingar (Middleton), Cromlyn (Battersby), Killynon, abundant (Reynell). WESTMORLAND: Ambleside (Buckton), Kendal district, Lakeside, Windermere (Moss), Witherslack (Murray). WEXFORD: Rosslare (Kane). WICKLOW: Tinahely (Bristow), Wicklow, Powerscourt, Arklow, Ashford, Newcastle (Kane). WILTS: Warminster (Greer), Devizes (Sladen). WORCESTER: Worcester (Edmunds), Bockleton (Decie). YORKS: more distributed than *porcellus* (Porritt), Selby district, northeast of the Humber district, Skipwith (Ash), Flamborough Head (Horton), Sandburn, (Hewitt), Helmsley (Archer), Glaisdale (Atkinson), Scarborough (Head), Askham Bog (Prest), Beverley (Davison), Bishop's Wood (Smethurst), Rossington (Warren), Sheffield (Doncaster), Wakefield (Talbot), York (Wilson), Hull district, Dairycoates (Holt), Everingham (Sumner), Huddersfield (Stainton).

DISTRIBUTION.—Over the whole of Europe and the greater part of Asia. Not yet, however, recorded from Greece, although it occurs in southern Russia, Bulgaria and Asia Minor. ASIA: China—northern, central aud western areas, Pekin, Chang Yang, Kiukiang, Omei-shan, Wa-shan, &c.; Japan—Shimonoseki, Gensau, Oiwake, Hakodaté, &c. (Leech), Chifu, Endermo (Fletcher), Corea—Pung-Tung (Fixsen), Amurland (Staudinger), Altai (Speyer), Kouldja—Kunjer, from 3000ft.—4000ft. (Alphéraky), northern India—Simla, Darjeeling, Silhet, Almora, Simla, &c (Boisduval and Moore), Punjab, common (Young); Sind, Himalayas, Shillong, Nàgas, Manipur (Hampson), River Witim in northeast Siberia (Herz); southwest Siberia—between Ust-Kamenogorsk and Ust-Buchtarminskaja on the Upper Irtish; eastern Siberia—near Pokrofka very rare, near Nikolajewsk, Mariinsk, Suifun, Baranowka, Wladiwostok, Sutschan (*teste* Bartel); Asia Minor, northern Persia—Astrabad; Irak (Young). AUSTRO-HUNGARY: Innsbruck, Taufers Valley (Weiler), Tyrol, lower valleys not common (Hinterwaldner), Bruneck in Puster Thal, 2600ft. (*teste* Bartel), Bukovina, distributed, but not observed in the higher mountains (Hormuzaki), Pressburg (Rozsay), Bohemia, Carlsbad (Nickerl), Galicia, not commou—Lemberg (Garbowski), Sambor (Nowicki), Neu Saudec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Schueider), Epiries, uot rare (Husz), Hungary—Kocsocz (Vangel), Noság, Transsylvania, Kaschau, Raab, Budapest, Heveser and Zipser Comitat, Fünfkirchen (*teste* Bartel), Gölnitz (Hudák), Upper Cariuthia—Salzburg, &c. (Nickerl), Pörtschach (Wägner), Friesach (*teste* Bartel), Lavantthal (Höfner), Upper Styria—St. Lambrecht (Kodermann), Linz district, not rare, Riesenhof, Buchenau (Himsl), Lower Austria—Vienna, Moravia—Mährisch Trübau, Ungarisch-Brod; Draga, near Fiume (*teste* Bartel). BELGIUM: generally distributed throughout, Namur, &c., common (Lambillion), Virton, very common (Derenne). CORSICA (*teste* Bartel). DENMARK: common, especially in damp places—Jutland, &c. (Bang-Haas). FINLAND: south and southeast Finland (Lampa), Lappmark rare (*teste* Bartel). FRANCE: commou throughout (Berce), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir (Guénée), Haute-Garonne, singly, nowhere commou—near Toulouse, Bouconne, Revel, Bagnères-de-Luchon (Caradja), Puy-de-Dôme—Clermont, sometimes very common (Guillemot), Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet), Doubs (Bruand), Aude (Mabille), Loire-Inférieure (Bonjour), Saone-et-Loire (Constaut), Seine-Inférieure (Viret), St. Quentiu (Dubus), Deux-Sèvres (Maillard), Sarthe (Desportes), Cannes (Constant), Aix-les-Bains, very common (Agassiz), depts. Meurthe-et-Moselle, Meuse, Paris district (Speyer). GERMANY: everywhere, not rare (Heinemann), northwest Germany, general (Jordan), Rhine Palatinate (Bertram), Wurtemberg (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich, very common (Kranz), Rudolstadt (Meurer), Mecklenberg (Schmidt), Bremen, common (Rehberg), Saxon Upper Lusatia (Schütze), Dresden, common (Steinert), Thuringia, not rare (Krieghoff), Prussia, not rare (Grentzenberg), Silesia, general (Assmann), Upper Lusatia, everywhere (Moeschler), Ratisbon (Schmid), Dessau, rather common (Richter); Alsace—Colmar (Peyerimhoff), Wernigerode (Fischer), Pomerania, common (Hering), Brunswick (Heinemann), Hanover, common (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Lübeck, not common (Paul), Chemnitz (Pabst), Hesse-Nassau—Biedenkopf (Rühl), Heligoland (Gätke), Berlin district, not rare (Pfützner), Rendsburg, Schleswig—Fleusburg, Hamburg, Lüneburg, Osnabrück, Crefeld, Elberfeld, Barmen, common, Ahrthal, Cassel, Leipzig, Würzburg, Ratisbon, Augsburg, Nassau, Frankfort-on-Main, Wiesbaden, Wetterau, Oberhessen—Brunnenthal, near Grünberg, Trier, Bavarian Palatinate (*teste* Bartel), Baden, common—Constance, Durlach, Carlsruhe, &c. (Reutti), Hildesheim, not rare (Grote). ITALY: common (Curò), Modena (Fiori), Sicily—Monreale, near Palermo, Madonie, Catania, Ficuzza, &c. (Minà-Palumbo), Roman Campagna, very

common (Calberla), Lombardy, Piedmont, Liguria, Tuscany, near Florence, Sardinia, Corsica (*teste* Bartel). NETHERLANDS: all provinces, not rare (Snellen), Breda, very common (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: Grumazesti, Comanesti, Slanic, Bucharest, Valeni, very common (Caradja). RUSSIA: Baltic provinces, throughout and not rare, Livonia—Dorpat, &c. (Nolcken), Moscow govt. (Albrecht), Crimea (Melioransky), Volga district (Eversmann), Transcaucasia—Borjom, Lagodekhi, rare (Romanoff), St. Petersburg (Erschoff), Gorki, Poland—Kamenez-Podolskii, Poltawa—Lubny, Jekaterinoslaw, Charkow, southern shores of the Crimea—Alupka, Lower Volga district, govts. Orenburg, Saratov, Sarepta (*teste* Bartel). SCANDINAVIA: not rare, northern limit Helsingland (Aurivillius), Lapland, rare (Lampa), not uncommon in southeast Norway (Siebke). SPAIN: Malaga (Rambur), Galicia—Santiago (Macho-Velado), Barcelona (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao, rare (Seebold). SWITZERLAND: almost everywhere, sometimes rare, sometimes common—Canton St. Gallen, to the hill region, common (Täschler), Grisons (Killias), Mettmenstätten (Dietrich), Basle, not rare, Bechburg (Riggenbach-Stehlin), Gadmenthal, to 4300ft (Rätzer), Canton Glarus (Heer), Upper Engadine, 5000ft.—5500ft. (Pfaffenzeller), Bern, not common (Hiltbold), near Lenzburg, Canton Lucerne—Seethal, near Wildegg, Flüelen, Weggis, near Vevey, the Valais (Wullschlegel), near Neuenstadt, general (Couleru), near Schüpfen, not rare (Rothenbach), near Bern (Meisner), near Zürich, rare (Frey).

Genus: THERETRA, Hübner.

SYNONYMY.—Genus: *Theretra*, Hb., "Verz.," p. 135 (*circ.* 1822); Stphs., "Illus.," iv., app. p. 5 (1835); "List Br. An. Brit. Mus.," p. 29 (1850); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, Linn., "Sys. Nat.," xth ed., pp. 492-493 (1758); xiith ed., p. 801 (1767); "Faun. Suec.," ii., p. 288 (1761); Müll., "Zool. Dan. Prod.," p. 116 (1776); Hfn., "Berl. Mag.," ii., p. 180 (1766): Fab., "Sys. Ent.," p. 544 (1775); "Spec. Ins.," ii., p. 149 (1781); "Mant.," ii., p. 97 (1787); "Ent. Syst.," iii., pt. 1, p. 373 (1793); [Schiff.], "Schmett. Wien.," p. 43 (1775); Ill's n. Ausg., p. 18 (1801); Esp., "Schmett. Eur.," ii., p. 97, pl. x., figs. 1-3 (1779); Bergs., "Sphing. Larv.," p. 10 (1782); Retz., "Gen. et Spec. Ins.," p. 34 (1783); Geoff., "Fourc. Ent. Paris.," ii., p. 255 (1785); Bork., "Sys. Besch.," ii., pp 64, 135, 178 (1789); Brahm, "Ins.-Kal.," ii., p. 313 (1791); [F.J.A.D]., "Rhein. Mag.," p. 314 (1793); Hb., "Eur. Schmett.," ii., fig. 60 (1796); text, p. 95 (*circ.* 1805); "Larv. Lep.," ii., Sph. iii., Legit. B. b., figs. 1 *a-b* (*circ.* 1800); Don., "Brit. Ins.," ix., p. 55, pl. 314 (1800); Schrk., "Faun. Boica," ii., 1, p 228 (1801); Haw., "Lep. Brit.," 1, p. 63 (1803); Latr., "Hist. Nat.," xiv., p. 131 (1805); Ochs., "Die Schmett., ii., p. 211 (1808); Leach, "Edin. Encycl.," ix., p. 130 (1815); Dalm., "Vet. Ak. Handl.," xxxvii., p. 215 (1816); Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," iii., p. 50, pl. xix., fig. 1 (1822); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); Meig., "Eur. Schmett.," ii., p. 135 (1830); Zett., "Ins. Lapp.," p. 916 (1840); Evers., "Faun. Volg.-Ural.," p. 109 (1844); H.-Sch., "Sys. Bearb.," ii., p. 85 (1846); Speyer, "Geog. Verb.," i., p. 315 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," i., p. 145 (1849); Bang-Haas, "Nat. Tids.," (3), ix., p, 401 (1874). *Deilephila*, [Lasp.,] "Jena. Allg. Lit. Zeit.," iv., p. 100 (1809); Ochs., "Die Schmett.," iv., pp. 42, 43 (1816); Stphs., "Illus. Haust.," i., p. 131 (1828); "Cat. Br. Ins.," ii., p. 33 (1829); Wood, "Ind. Ent.," fig. 19 (1839); Dup., "Icon. Chen.," pl. v., fig. 1 (*circ.* 1835); "Cat. Méth.," p. 42 (1844); Bdv., "Icon. Chen.," pl. iv., figs. 3—4 (*circ.* 1840); "Gen. et Ind. Meth.," p. 46 (1840); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Staud., "Cat.," ed. 1, p. 16 (1861); 2nd ed., p. 37 (1871); Snell., "De Vlind.," p. 94 (1867); Berce, "Faun. Franç.," ii., p. 24 (1868); Snell. v. Voll., "Tijd. v. Ent.," xiii., p. 146, pl. vi., fig. 1 (1870); Mill., "Icon.," pl. cxvi., fig. 7 (1870); "Cat. Lép. Alp.-Mar.," p. 118 (1872); Curò, "Bull. Soc. Ent. Ital.," vii., p. 112 (1875); Frey, "Lep. Schweiz," p. 58 (1880); Weism., "Stud. Theory Descent," transl. p. 184 (1882); Auriv., "Nord. Fjär.," p. 46 (1889); Meyr., "Handbook," &c., p. 295 (1895); Bart., "Palæark. Gross-Schmett.," ii., p. 123 (1900). *Sphinx* (*-Spectrum*), Latr., "Gen. Crust. et Ins.," iv., p. 210 (1809). *Elpenor*, Oken, "Lehrb. Zool.," i., p. 761 (1815). *Eumorpha*, Hb., "Franck's Cat.," p. 87 (1825). *Choerocampa*, Dup., "Hist. Nat.," supp. ii., pp. 159—160 (1835); Humph. and Westd., "Brit. Moths," i., p. 23 (1841); Dbldy., "List Brit. Lep.," p. 3 (1847); Sta., "Man.," i., p. 97 (1857); Humph., "Gen. Br. Moths," p. 11, pl. iii., figs. 3—4 (1860); Wallgrn., "Skand. Het.," i., p. 46 (1863); Newm., "Brit. Moths," p. 10 (1869); Bdv., "Hist. Nat.

Sphing.," p. 280 (1875); Kirby, "Eur. Butts. and Moths," p. 72, pl. xvi., figs. 4 *a—b* (1879); Buckl., "Larvæ," &c., p. 116, pl. xxvi., figs. 1 *a—c* (1887); Barr., "Lep. Brit.," ii., p. 55, pl. lii., figs. 2, 2*a* (1895); Tutt, "Brit. Moths," p. 31 (1896). *Metopsilus*, Dunc., "Brit. Moths," p. 163 (1836); Kirby, "Cat.," p. 660 (1892); "Handbook," &c., iv., p. 26 (1897); Staud., "Cat.," 3rd ed., p. 104 (1901). *Pergesa*, Walk., "Cat. Lep. Het.," viii., p. 149 (1856); Maassen, "Stett. Ent. Zeit.," xxix., p. 437 (1868).

This genus was diagnosed (*Verz.*, p. 135) by Hübner, about 1822, as follows:—

Both pairs of wings exteriorly with dentate bands; hindwings shaded with yellow and black—*Theretra equestris*, Fab., *T. nechus*, Cram., *T. porcellus*, Linn., *T. tersa*, Fab.

It will be observed that the original genus *Theretra* is hopelessly heterotypical, but Stephens fixed the type as *porcellus*. In his appendix to vol. iv of the *Illustrations*, Stephens published a list of the British lepidoptera contained in the *Verzeichniss* under Hubner's genera and we find *Theretra (porcellus)* mentioned as one of the subdivisions into which Boisduval's *Deilephila* is broken, whilst the same author again used *Theretra* for *porcellus* in the *List of the British Animals in the Collection of the British Museum*, pt. v, in 1850. This renders nugatory Moore's later restriction (*Lep. Ceylon*, ii., p. 22) in which he makes *nessus* the type of Hübner's genus *Theretra* (see, *antea*, vol. iii., p. 351, footnote). Later authors, Kirby, &c., who have considered *porcellus* as generically separate from *elpenor*, have used the name *Metopsilus*, Dunc., of which, however, Westwood, in 1840, fixed the type as *elpenor* (thus making it synonymous with *Eumorpha*), for the former species. *Metopsilus*, Dunc., is also not only a heterotypical genus, but comprises genera belonging to widely different Eumorphid (Chœrocampid) tribes. The diagnosis reads:—

The antennæ are but slightly clavate, the anterior wings very acute at the apex, with a slight sinuosity or emargination on the hinder margin, just below the tip, which gives them a somewhat falcate shape; the inner margin likewise deeply emarginate behind the middle. The larvæ offer several very distinctive marks, particularly that of having the anterior segments very much attenuated, and capable of being drawn within each other; a peculiarity which has caused them, as was formerly noticed, to be named "Chenilles cochonnes" by French naturalists, because the head and neck bear some resemblance to a pig's snout. These caterpillars are not distinguished by great brilliancy or variety of colours, being chiefly brown and green, with a white lateral line extending from the anal horn to the third or fourth segment, and they have invariably two or three large eye-like spots on each side, either of the second, third, fourth or fifth segments. The caudal horn is short, very slightly bent, sometimes almost obsolete. The chrysalis is enclosed in a loose cocoon, formed of leaves, and is never buried beneath the soil. The perfect insects are very beautifully coloured, and it is observable that the abdomen is always longitudinally or obliquely striped, an arrangement different from that which obtains in the two preceding genera, which have that part of the body ornamented with transverse bands, sometimes of different colours. Viewed in relation to the form of the larvæ as well as to the appearance of the perfect insects, the species which we have placed together, under the above name, form a very natural group—*nerii*, *celerio*, *elpenor*, *porcellus* (Duncan, *Naturalist's Library*, xxx., pp., 154-155).

The genus *Theretra*, according to Staudinger, contains three Palæarctic species—*porcellus*, L., *syriaca*, Ld., *mongoliana*, Butl. This grouping is utterly impossible. The larval structure of *syriaca* certainly excludes this species from the tribe *Eumorphidi* (see *anteà*, p. 37, footnote). Weismann describes the larva (*Studies in the Theory of Descent*, p. 191) as: "Green, having the short

oblique stripes over the legs common to so many Chœrocampid species, the only markings besides these being a simple white subdorsal line, without any trace of eye-spots. The larva, therefore, corresponds with the second ontogenetic stage of *Eumorpha elpenor* and *Theretra porcellus*." The larva is referred by Weismann to his group 1 (*anteà*, p. 57), but is, possibly, even more generalised than *Darapsa*. Weismann's group 1 is undoubtedly quite tribally distinct from our *Eumorphidi*. Bacot notes that the imago of *Clarina syriaca* has a very Amorphid-like general appearance, both in colour, pattern of markings and shape, and, superficially, suggests somewhat some of the moths of the Sichiid stirps. With *Darapsa*, it appears to have distant affinities, but is probably not to be included in the same tribe; the larvæ of the species of the latter genus are figured as having much more marked retractile head and thoracic segments. These species have no real affinity with *Theretra porcellus*. Bacot further notes, as to *mongoliana*, that it is almost certainly tribally distinct from the *Eumorphidi*, but that one cannot tell, without larvæ for examination, whether the difference is really generic or tribal. Kaye places it in an entirely different group, which he describes thus:

1. Head short, closely set to thorax; antennæ short in ♀; legs slender, not long: wings, head and abdomen strongly suffused with pink—*elpenor*, *porcellus*.

2. Head medium-sized; antennæ shorter in ♀ than ♂, but not markedly so; legs fairly long and robust; head, wings and abdomen strongly suffused with greenish—*olivacea*, *olivata*, *gloriosa*, *aurifera*, *albicosta*, *velata*, *mongoliana*.

At any rate, it appears fairly evident that the three species included by Staudinger in this genus belong not only to different genera, but to characteristically different Eumorphid tribes.

Theretra porcellus, Linné.

Synonymy.—Species: *Porcellus*, Linn., "Sys. Nat.," xth ed., p. 492 (1758), &c. *Bombyliformis*, Linn., "Sys. Nat.," xth ed., p. 493 (1758). [Except for this last-named reference, referred by Linné himself to *porcellus* (*loc. cit.*, xiith ed., p. 801, var. β), all the references included under the generic synonymy *Theretra* (*anteà*, pp. 89-90) are referable to the specific name *porcellus*.]

Original description.—*Sphinx porcellus*, alis integris flavicante purpureoque variis; inferioribus basi fuscis. Roes., *Ins.*, i., phal. 1., t. 5. Habitat in Epilobio, Impatiente. Simillimus priore (*elpenor*) ut facile idem insectum, sed larva minor, nigra, absque cornu (Linné, *Sys. Nat.*, xth ed., p. 492). [This is later extended to: "Simillimus priori (*elpenor*) ut facile idem insectum, sed larva minor, nigra, absque cornu; declaratus vero thorace antice posticeque rubro. Alis primoribus absque fasciis, absque puncto albo, absque margine tenuiore albo; posticis vero basi fuscis. Abdomine supra absque linea rubra" (*Sys. Nat.*, xiith ed., pp. 801-802).]

Imago.—48mm.-54mm. Anterior wings dark yellow-ochreous with a tinge of brown (or olive-brown); costal area between upper edges of transverse lines blotched with rosy-crimson; outer marginal area rosy-crimson; four olive-brown oblique transverse lines from costa to innermargin, rather darker than ground-colour; cilia rosy-crimson. Posterior wings with the basal area blackish, a dark yellow-ochreous median band, outer band rosy-crimson; cilia white, variegated at ends of nervures with rosy-crimson.

Sexual dimorphism.—The antennæ differ as in other Sphinges, the ♀ being without the long pocket-forming hairs. In addition the ♀ antenna is shorter (9·5mm.-10·8mm.) than in the ♂, it is very distinctly more slender ·34mm. to ·40mm., and appears to be more clubbed, the ♂ antenna reaching its greatest thickness from about the 30th to 40th joints, thence declining at first very slightly, the ♀ antenna does not reach its greatest thickness till it reaches the 40th joint, and maintains it till it reaches the 45th, thence declining more rapidly than does that of the ♂. In both sexes the terminal bent point involves 8 to 10 segments. The minute terminal joint of the palpi seems rather better developed in the ♂, and its included cavity more obvious. It is possible to believe that the scaling of the antenna is in three definite rows, but they are so irregular that an unbiassed description would rather note them as without very definite arrangement. The anterior tibial spurs differ a little in the two sexes, but very little, those of the ♂ being about 1·50mm. long, of the ♀ 1·33mm. The ♀ is more robust, and, as in *Eumorpha elpenor*, the tapering to the apical point of the abdomen is confined in the ♀ to fewer terminal segments than in the ♂ (Chapman).

Variation.—There is considerable variation in the amount of yellow and rosy tints, as well as in the intensity of the lines, observable in this species. The thorax and abdomen sometimes entirely rosy, sometimes almost entirely olive-ochreous with only a slender rosy collar and median area to thorax, and rosy sides to abdomen. As a race the Perthshire examples are very striking, the ground-colour very distinctly olive-ochreous, the transverse line well-developed, the costal patches pinky-crimson, the patch between the second and fourth transverse lines often continued to the inner-margin. The hindwings somewhat suffused, at the apex the outer-marginal area also somewhat suffused=var. *scotica*, n. var. The western Irish specimens have a markedly yellower ground-colour, the 1st, 2nd and 4th lines developed, but the 3rd nearly obsolete, the normal red patches on the costa and outermargin often more or less obsoletely marked with pinky-grey, giving the wings an unicolorous appearance, the discoidal lunule fairly distinct, the hindwings also more uniform, the basal area not very dark, and the outermargin only faintly red=var. *hibernica*, n. var. The South Wales specimens rather incline to the Irish type. The British examples from Nottingham approach the well-marked Scotch type, but have the red of a much deeper crimson tone, whilst the Kent and Sussex examples often have the transverse markings almost obsolete, the crimson-red, however, being well marked. In our collection the following appear to be the chief forms:

(1). Anterior wings, ground-colour clear yellow-ochreous, transverse lines almost obsolete, red areas of a bright rose. Posterior wings with dark basal area well developed, marginal area faintly red with dark shading, central fascia same tint as ground-colour of forewings=*porcellus*, Linn. [Linné's typical description appears to refer to this form. "Purpureum" is possibly only a general term for purple-red or red.]

(2). Anterior wings, ground-colour olive-ochreous, transverse lines ill-developed, red parts bright crimson; the three areas of the posterior wings equally clearly separated=ab. *clara*, n. ab.

(3). Anterior wings, ground-colour olive-ochreous, transverse lines well-marked, red parts bright crimson; the central and red parts of hindwings somewhat dark-shaded=var. (et ab.) *scotica*, n. var. (et n. ab.).

(4). Anterior wings, ground-colour olive-ochreous, transverse lines well-marked, red parts ill-developed, rosy-grey in tint; the hindwings with the outer area suffused and with only slight traces of reddish=ab. *indistincta*, n. ab.

Oldham captured (*Proc. Sth. Lond. Ent. Soc.*, 1888, p. 68) an aberration with the usual pink blotches along the costal margin of the forewings narrower, and of a much lighter shade than in most specimens, whilst the broad outer margins are somewhat indistinct. Tugwell notes (*Young Nat.*, x., p. 43, and *Proc. Sth. Lond. Ent. Soc.*, 1888, p. 129) an aberration, bred January 28th, 1889 (from a forced pupa, the larva from Kingsdown), as having "the usual deep rose-colour almost absent, only the rose-coloured body being normal, the forewings with a fine rose-coloured narrow streak along the costal margin, the whole of the disc of the wing being of a faint bright olive-green with a faint show of grey shade on the inner margin. The inferior wings are greenish with faint grey-brown shades along the inner margin." Moncrieffe captured, at Moncrieffe, an aberration in which the ordinary colour is replaced by grey with lemon markings (*Ent.*, xi., pp. 103, 169, pl. ii., fig. 3). Bartel notes (*Pal. Gross-Schmett.*, ii., p. 125) an aberration in which the outer margin on the upperside of the hindwings, which is rose-red in normal specimens, has the blackish tone of the inner-marginal half, so that the red colour has entirely disappeared, while the yellowish-green is confined only to a weak, dusky, central stripe; there is also a considerable difference on the underside of the hindwing; in the typical form the outer margin is broadly red, sharply bounded by black towards the base, but in this aberration the margin is light grey, only weakly tinged with red, and shades off gradually into the yellow colour of the central area. Examples in which the hindwings are much suffused with blackish might be termed ab. *suffusa*, n. ab. Rothke in his fauna of Crefeld, mentions a bred example of *T. porcellus* which was almost entirely scaleless, but in which, unfortunately, the hindwings were slightly crippled. The following appear to be the only named forms of the species:

a. ab. *lutescens*, Ckll., "Ent.," xx., p. 152 (1887); "Proc. South Lond. Ent. Soc.," 1887, p. 101 (1888). *Porcellus* ab., Carr., "Ent.," xi., p. 169, pl. ii., fig. 3 (1878).—A very pale aberration, in which all the rosy-crimson of the normal examples of the species is replaced by yellow, and the coloration much subdued. Captured at Moncrieffe by Sir Thomas Moncrieffe, and is in beautiful condition (Carrington). The normal pink replaced by yellow. Perthshire (Cockerell, with reference to *Ent.*, xi., p. 169, pl. ii., fig, 3).

Bartel notes (*Pal. Gross-Schmett.*, ii., p. 125) that greenish-yellow aberrations, in which the red has quite disappeared, have occurred rarely in several localities in northern Germany. He supposes that these may belong to an analogous form to that to which Heylaerts alludes in his *Macrolep. Fauna of Breda*, and which was found freshly emerged on May 26th, 1869. It is figured on pl. vi., fig. 1, and is distinguished, so far as can be seen from the figure, by its entire lack of red colour on the forewings. This is replaced by a yellowish-brown, in which the somewhat darker markings are by no means prominent. Hindwings yellow in the middle, light rose-colour before the outer margin.

β. var. *suellus*, Stgr., "Hor. Soc. Ent. Ross.," xiv., p. 298 (1878); "Rom. Mém.," i., p. 71, pl. iv., fig. 1 (1884); "Cat.," ed. 3, p. 104 (1901); Kirby, "Cat.," p. 660 (1892); Bartel, "Pal. Gross-Schmett.," ii., p. 127 (1900). *Porcellus* var., Led., "Ann. Soc. Ent. Belg.," xiii., p. 28 (1869).—In size, form and formation of antennæ, &c., *suellus* entirely agrees with

porcellus. The difference lies solely in the pale green-yellowish colour, and the more prominent markings of *suellus*. The fine red of *porcellus* has here quite disappeared, only the one specimen from Hankynda has a very faint tinge of red. On the forewings, two dark transverse lines are distinctly expressed, the first, behind the close of the median cell, is somewhat broader and more indistinct, and an indistinct spot is appeuded to it in the median cell; the second (outer) line is very sharply defined. They likewise appear on the underside, and here they are distinctly continued into the hiudwings. Indications of these lines are also fouud in *porcellus*. Close under the darker apex of the forewings there is in *suellus* a whitish mark, the upper part of the red outer margin of *porcellus*, which is indicated in all *suellus*. Between this outer-marginal part and the outer transverse line one finds also the broad greenish band of *porcellus*, naturally much narrower. The outer-marginal part of the hindwings is black on the upperside in three of my *suellus*, in one it is dirty yellow, like the ground-colour. Head, thorax and abdomen are greenish-yellow, the latter more grey. On the head, instead of the reddish stripes of *porcellus*, there are two white ones. The epaulettes are strongly white externally, the prothorax very narrowly bordered with white. The white lateral spots of the last abdominal segments of *porcellus* are here light yellow, and the segments are here laterally touched with a golden colour. The abdomen in the specimens from Amasia and Borjom is tinged with pale reddish. My greenish-yellow aberrations of *porcellus* from Germany differ markedly from *suellus* in their less distinct markings, the lack of the white border of the epaulettes, and of the gold-varnish coloured abdominal spots, &c. DISTRIBUTION: Almost more distributed in Transcaucasia than the type--Tiflis, Borjom, Lagodekhi, Istissou, Hankynda, Souanétie. Asia Minor—Amasia, Tokad (Staudinger).

Bartel notes (*Pal. Gross-Schmett.*, ii., p. 127): "This form is so very different from the type that one is not surprised at the opinion of Radde, who considered it to be a distinct species, a point which Staudinger still leaves undecided. It may be distinguished at once from the greenish-yellow aberrations of *T. porcellus* from Central Europe by its less distinct markings, by the lack of broad-white borders to the epaulettes, the glossy golden-yellow abdominal spots and other characters. This variety is found in Transcaucasia in the same localities as those frequented by *T. porcellus*, is especially attracted by the blossoms of *Lonicera caprifolium*, but has been taken at light in Amasia late in the evening, when it was quite dark. It is confined to Transcaucasia and Asia Minor, being, in the south and south-west Caucasus, perhaps more widely distributed than *T. porcellus*.

EGGLAYING.—The eggs are firmly attached to the leaves and stems of *Galium verum* (Tutt); fastened to leaves near the top of the shoots of bedstraw and appear to be usually placed on the underside of the leaves. According to Schütze, who has often observed it ovipositing, the female always chooses the poorer plants on which to lay its eggs. The ova are placed singly on the stems and leaves of *Galium verum*, many being found thus at Eastbourne from June 29th—July 12th, 1901; at the latter date, however, most of those observed had already hatched (Ransom). Montgomery notes that at Eastbourne, in 1900, he searched *G. verum* on the downs, and found, between June 25th and July 1st, 113 ova, usually not more than one on a stem. The flowering stems produced none, but the shorter stems, whenever in sufficient quantity to search, generally produced ova. Eggs were also found on plants mixed with *Galium*, one blade of grass had three, each half an inch from its neighbour, and each of several flower-stems of hawkweed had a single egg. He adds that ova of *T. porcellus*, kept in confinement, should be placed

on a piece of damp rag and kept in a metal glass-topped box, and observes that a batch of ova, not so treated, although developing well until the final stage, failed to produce their larvæ, whilst of another batch, placed on the damp rag, 98 out of 110 hatched, and none of the 12 failures contained a larva. Holland notes that the eggs are usually laid 2 or 3 together.

Ovum.—Small (for a Sphingid egg), oval (some approaching circular) in outline, the upper surface much indented, a circular depression occupying the greater part of the top; the surface of the egg is covered with a faint polygonal reticulation, and the egg has the appearance of being spotted all over with small, whitish, deep-seated pits, colour bright pea-green [Described July 10th, 1901, from eggs received from Mr. Head]. As the egg gets older the colour becomes pale greenish-yellow, and the embryo is very distinctly seen inside, the black tubercular setæ being seen very clearly through the eggshell (Tutt). Smooth, rounded, oval in outline, a deep depression on the upper (unattached) side; 1·2mm. long, 1·05mm. wide, and rather less in thickness; colour vivid green, surface covered with a faint and irregular cell reticulation, the walls consisting of a raised network, enclosing depressed areas, the walls broad but exceedingly low; nothing definite can be made out of the structure of the micropyle [Bacot, June, 1901. Eggs about to hatch; received from Mr. W. Barnes]. Very broad, oval in form, 1.2mm. long, 1mm. wide; the shell thin and shiny, colour light green (Hellins). Light green in colour, spheroidal in form, very similar to those of *Eumorpha elpenor* (Weismann). Bartel describes the egg as "oblong-oval, greenish, covered on upperside with many black dots"; these black dots are evidently the tubercles of the embryo showing through the transparent shell.

Habits of larva.—The newly-hatched larva eats a considerable portion of the eggshell, at least one-third, it never seems to eat the whole. As soon as it settles down on its food it rests on the underside of the leaf which is, in the case of *Galium verum*, just wide enough to hide it from above (Bacot, June, 1901). The newly-hatched larvæ seemed at first to like the flowers of *Galium verum*, but very soon altered their taste and showed a preference for the leaves, apparently not caring to touch the flowers when a fresh supply of food was given to them. Some that hatched July 20th, 1886, moulted four times, *viz.*, July 25th, July 31st, August 6th, and August 11th (Hellins). The larva lives at the same time as, but rarely in company with, that of *E. elpenor*, the larva affecting rather meadows and sunny slopes than ditches, and preferring dry localities, whilst that of *E. elpenor* is found chiefly in damp situations (Bartel). The fullgrown larvæ may be sought at the end of July on the various species of *Galium*, from 8 p.m. to midnight, with a lantern, the larvæ being often thus found in large numbers. In some years they are (with the larvæ of *Sesia stellatarum*) very abundant on the stunted plants of *Galium* growing on the Kent coast from Deal to Dover, but are difficult to find during the day. Some 30—40 larvæ were taken in the autumn of 1872 with a lamp after dark at Painswick (Watkins), on the sandhills between Waterloo and Formby, and between New Brighton and West Kirby, also

near Yarmouth the larva appears to prefer *Galium* of considerable growth intermingled with coarse grass, amongst which it hides low down, and is not easily discovered, but may be traced by its long pellets of black frass; near Kendal it affects chiefly the borders of the large tracts of mossland, where it is always associated with *Galium mollugo*, growing in thick patches among the grass, especially at the side of the dykes. The young green larva is more easily detected than after it has assumed its dark coat, and owing to the growth being so thick, it is hardly possible here to trace it by the frass (Moss); larvæ difficult to find in daytime, they strip a spray of bedstraw, leaving the bare stem, and hide by day among roots of grass and bedstraw as near ground as possible, where their colour renders detection difficult; at the end of July, 1895, four hours' work in daytime at Malvern Wells provided 4 nearly fullfed larvæ, the same place at 10 p.m. with lantern gave 10 larvæ in 10 minutes; at this time there was a drizzling rain, which caused the larvæ to have the appearance of large snails glistening in the light from the lantern (Rodgers); in the Namur district the larva lives on rocky ground, eating only in the night and early morning, remaining during the day at the roots of the foodplant (Lambillion). Wailes found larvæ in the early morning of a wet, gloomy day, but the following day they could only be obtained by disturbing the sand at the roots of the plants; he also states that Blomer, when in Egypt, used a garden rake successfully for this purpose; Robson says that the larva prefers a sandy habitat, perhaps because it can burrow in the loose sand during the heat of the day. Holland observes that, during August, *G. verum* and *G. mollugo* should be searched with a lamp after dusk for larvæ, which are always well hidden away in the daytime. Larvæ found from 10 p.m. to midnight with a lantern, on Esher Common (Lovis), [nearly fullfed larvæ on August 4th-18th at Bisterne, feeding at mid-day in the hottest sun (*Subs.*, p. 20),] larvæ found abundantly at Cherryhinton, July 31st, 1900, between dusk and 11 p.m., by lamplight, mostly of the brown form, but a few green ones, on *G. verum* (Crisp), larvæ fairly common from August 11th-27th, 1900, on yellow bedstraw on the cliffs at Folkestone, and readily found with a lantern at dusk as they crawl up the bedstraw to feed on the top shoots, of some three dozen captured five only were of the green form (Pickett). July and August are the great months for the larvæ, but there is some variation. The following dates for the capture of larvæ have accumulated: July and August at Pöstlingberg (Himsl), July and August at Namur (Lambillion), July to September in Germany (Kaltenbach), September 7th, 1882, fullgrown, on the Pic du Midi de Bigorre at 6000ft. (Jones), August 30th, 1856, larva at Ramsgate (Powell), 13 larvæ on *G. verum* between July 26th and August 26th, 1857, at Ilfracombe (Mathew), larva August 20th, 1857, at Brighton (Merrifield), larvæ common June 26th, 1858, at Perth (White), larvæ August 19th, 1860, at Jersey (Johnson), on Deal sandhills from September 1st-6th, 1860 (Fenn), fullfed larvæ on July 29th, 1861, August 2nd, 1866, August 26th, 1869 (Buckler), larvæ found on outskirts of Chelsea at the beginning of August, 1863 (Clifford), August 5th, 1865, at Rottingdean, August 21st, 1869, at Hollingbury Coombe (Image), June, 1867, at Perth (Stewart), August 8th,

1867, larvæ at Deal (A. H. Jones), larvæ near Whitby, end of August, 1868 (Bold), August 9th, 1871, at Wanstead (Burrows), 70 larvæ at Brighton in August, 1871 (Edmunds), larvæ plentiful on August 6th, 1874, at Streatley, July 30th, 1881, at Pangbourne, July 28th, 1889, in plenty at Southstoke, August 19th, 1890, at Hardwick, August 7th, 1892, at Sulham (Holland), August 23rd, 1879, at Cleethorpes (Auld), August 31st, 1883, at Riddlesdown, August 18th, 1890, at Freshwater (Sheldon), August, 1888, at Dunham, near Manchester (Chappell), larvæ nearly fullfed on August 3rd, 1888, August 19th, 1894, August 11th, 1895, August 16th, 1896, all at Reading (Butler), larvæ very abundant at Deal September, 1888 (Nash), August 12th, 1889, August 8th, 1892, August 3rd, 1893, at Barnes, August 8th, 1890, at Eastbourne (Sich), larva at Swanage on August 5th, 1890 (Freeman), August 28th, 1892, at Panton, August, 1898, at Dover (Raynor), July, 1895, at Malvern Wells (Rodgers), larvæ three-quarters fed on June 21st, 1896, at Castle Cosey (Thornhill), August 19th, 1896, at Luffness Links (Evans), June, 1898, nineteen larvæ taken about three-parts grown, small larvæ on August 12th, 1898, all at Chelmsford (Miller), July 17th, 1899, at Benfleet (Whittle), fully grown larvæ on downs at Eastbourne on August 10th, 1899 (Carr), July 31st, 1900, at Cherryhinton (Crisp), larvæ fairly common from August 11th-27th, 1900, on the cliffs at Folkestone (Pickett), larvæ fullfed September 3rd, 1900, at Irvine (Dalglish), larvæ July 23rd-August 6th, 1901, in a meadow near Sudbury (Ransom), August 28th, 1901, at Hartley Links (Rosie), larvæ August 20th-29th, 1902, near Burgess Hill (Dollman), August 25th, 1902, quite small, at Perth (Bush).

LARVA. — *First instar* (newly-hatched): About 3mm. long, stout, sturdy-looking, very short in comparison with length; prolegs short (larva rests low on foodplant); the head large and rounded; body tapering slightly from head to anus; the head green in colour, the body duller whitish-green; the skin-folds at segmental incisions strongly marked; the setæ dark, very short, forming little tubes with a drop of clear viscous fluid at tip; the spiracles large, slightly raised on abdominal segments 2, 3, 4, 5 and 6, the prothoracic and 8th abdominal spiracles very large and the 7th one also much enlarged, nearly, if not quite, as large as that on the 8th, whilst that on the 1st abdominal is also enlarged, though not to the same extent as those on the 7th and 8th; the caudal horn is only represented by a small brown circular mound, bearing the two anterior trapezoidals (i) at its summit; this is situated at about the middle of the 8th abdominal segment on a slightly raised skin area (and is less conspicuous * even than the caudal horn of *Dimorpha versicolora)*. [When two days old the larva examined showed a sharp, clear, dark, mediodorsal line, and a rather broader, less sharp, white, subdorsal line, running from the prothoracic scutellum to the base of the caudal horn (neither of these characters noticeable at

* This must clearly be looked upon as a case of degeneracy in what may be termed an atavistic manner, since the tubercles and their width apart are in great contrast with the usual aspect of the Sphingid horn, and in marked contrast to the atrophy that is more or less in evidence in the adult larvæ of *Sphinx ligustri* and *Eumorpha elpenor* (Bacot).

hatching).] The abdominal segments have 6* clearly marked subdivisions, the first of which is equal to any three of the others in size (and is structurally divisible into 3) and bears tubercle i, ii being situate on subsegment 4; this 1st subsegment is almost certainly a coalescence of three original subsegments as it is quite unusual to find tubercle i on the 1st subsegment of larvæ, when the subdivisions are so numerous, unless it be much larger than those following. In this case there would be 8 subsegments to a segment, the normal number in Sphingids. The prothorax bears a large, but not very clearly defined, scutellar plate, and the 10th abdominal a distinct and well-defined anal plate. The tubercles on the abdominal segments are—i and ii, in usual trapezoidal position, placed well apart, and ii considerably farther from median line than i; iii close down to the spiracle on the 1st subsegment; iv and v are well below spiracle, iv almost directly beneath, but slightly posterior; on the 7th† and 8th abdominal segments this tubercle bears a simple pale-coloured hair instead of a dark glandular bristle; v is below the level of the spiracle, but placed far forward on the 1st subsegment, near the anterior margin of the segment. On the mesothorax and metathorax i and ii are still trapezoidal, but not so widely separated as on the abdominals, iii is double and bears two setæ; of the subspiracular tubercles v only is visible, beneath and anterior to spiracle, almost on margin of segment (iv if present at all must be very minute and certainly does not carry a glandular hair). ? *Second instar* (July 17th, 1898): Short, stout, heavy in appearance; about ·3in. in length, head rounded with a slight tendency to square (*i.e.*, flattened at top and sides), rather larger than thoracic segments; the abdominal segments slightly larger, the thoracic segments having slightly the appearance of a neck. *Head* pale green in colour, surface dull; numerous short scattered hairs, black or very dark purple in colour; division of head lobes distinct. *Body* fairly evenly cylindrical, slightly humped on 8th abdominal; the caudal horn represented merely by a central tubercle of conical shape; the terminal abdominal segments slope off rapidly from horn to anus: colour pale green with a whitish tinge on dorsal area; tip of caudal horn (tubercle) dark purple or black; a broad white subdorsal band starts on either side of head and runs back to the end of the 7th abdominal almost horizontally, it then slopes up to base of caudal horn; these bands are bordered above by a clear green stripe and fade off gradually into the green ground colour beneath; a faint green mediodorsal line is also present; the segmental incisions distinct and sharp, but not deep; scattered dark purple or black shagreen hairs are fairly numerous but not nearly so thick as in

* The larvæ at this stage had the first three segments of the abdominals markedly joined as one (Bacot).

† It may be observed that, in the larva of *Hemaris tityus*, tubercle iv, on the 7th abdominal segment, carries a pale, simple, unforked hair, whilst the other hairs are dark in colour and highly forked. This possibly shows a tendency to weakness in this particular hair on this segment, and it may very possibly be of general occurrence throughout the superfamily, although more noticeable in these species owing to the special development of their hairs. In larvæ where the hairs are all small and weak or unspecialised the tendency may be easily overlooked (Bacot).

Amorphids, they rise from small conical tubercles of usual shagreen type, whitish or yellowish-white in colour, less marked on the clear green border to the subdorsal stripe; subsegments clear and distinct, 6 on each abdominal segment, the first equal in size to any three of the others, and, as before noted, structurally equal to three, thus giving 8, the normal number of subsegments in Sphingid larvæ; apparently 6 also on the mesothorax and metathorax but they are all equal in size and rather larger than the small abdominal ones; the shagreen-hairs are rather thick and short, not bifid, but apparently glandular in character; what looks like minute drops of a yellowish substance can be made out on some of the hairs. ? *Third instar* (August 4th 1898): No change in general character from last instar. Grows to ·75in. in this stage. Head paler green than the body, and, when the larva is fullgrown in this stage (as also when adult), is very small compared with the size of the body. The broad white subdorsal body-stripe clear and strong, turning up to the root of the caudal horn as in the larva of *Sesia stellatarum*; the mediodorsal line clear; the bases of the shagreen tubercles white, the white spreading somewhat from base; the subdorsal band much whiter on the 1st and 2nd abdominal segments than elsewhere, swelling out into a distinct spot on each of these segments (much larger on the 1st than the 2nd abdominal); on the 1st abdominal segment a dark spot of reddish or purplish hue just below the white spot or swelling of the band; this dark spot bordered below with whitish; on the 2nd abdominal only the faintest trace of a dark spot; anal flap narrowly bordered with white. ? *Fourth instar* (August 7th, 1898): The subdorsal band much less prominent, that portion on thoracic segments the strongest; colour of larva still green; faint oblique (tail to head slope) stripes discernible; the caudal horn still represented by a central, dorsal, pale-coloured tubercle, its double character easily made out from the two short shagreen-hairs that surmount it, the white from the bases of these hairs divided centrally by a narrow green streak; spiracles large, oval, surrounded by a narrow, chitinous rim; shagreen-hairs very short, more numerous than in previous instar, and white specks at their bases more conspicuous; green of lateral area rather whiter than on dorsal area; the swelling of the subdorsal band on 2nd abdominal segment has now developed into a circular creamy-white spot, bordered above and below by a dark streak; that on the 1st abdominal is much larger; it consists of an oval, creamy-white spot (quite twice the size of that on 2nd abdominal), bordered above by a narrow black streak and a rather suffused but broader reddish band; below the white is a band of dull red, broader in centre and narrower at ends; this fades into flesh-colour below, this tint forming a tolerably broad spot, thinning out posteriorly into a narrow streak; below this again is an intense velvety-black spot, of irregular lunular shape, broader in front than at back, the whole forming a distinct ocellated spot. The ocellated spots show up more clearly in this stage, partly because they are stronger and the colour contrast greater, and partly because the subdorsal bands are fainter than before. Dark, smoky-coloured larvæ are sometimes met with in this stage. ? *Fifth instar* (adult): All my larvæ are

now dark in colour; the resemblance to the larva of *Eumorpha elpenor* is very close; the larva darkest directly after moult, as it grows it pales to a sepia-grey. Head somewhat square, with alternate dark and pale vertical stripes; surface dull, covered with a short growth of fine hairs; the head and thoracic segments small, the latter tapering rapidly from 1st abdominal segment to head, both head and thoracic segments retractile to a considerable extent. A dark mediodorsal line and pale subdorsal stripes, bordered with black, are noticeable on thoracic segments; traces of subdorsal band observed on abdominal segments, most marked on 7th and 8th; the intersegmental areas pale, and there are pale spots in the position of the trapezoidal tubercles; caudal horn very insignificant, rather pale coloured; anal flap with pale border; subsegments clearly marked, 6 (structurally 8) on each abdominal segment, the first (really 3 structurally) equal in size to three or four of the following ones; both ocellated spots large and well-developed; a black blotch in about same position on metathorax; traces of the 7 oblique stripes are present. The dark colour is due to black streaks and mottling on a pale greyish ground; other whitish spots are present in addition to the trapezoidal ones, the latter, however, clearest and most conspicuous; shagreen-hairs still present, and easily seen with an 1″ objective; spiracles white (Bacot). The *newly-hatched larva* is a little over 3mm. long; on segment 12 no horn, but a raised wart set with two clubbed bristles, as if the horn had been absorbed, leaving no more than its tip, the places of the usual tubercular dots marked by tiny short knobbed black bristles; the head and segment 13 set with short black hairs; the colour pale grey-green on the back, on the front of each segment a band of deeper tint than that on the hinder part, the side greyer, the spiracular region almost whitish, the head and belly pale yellower-green; in a day or two a whitish subdorsal line, with edges rather darker than the ground-colour, makes its appearance. The *first moult* comes when the larva is 6mm. long. After the moult the skin shows eight subdivisions in each segment set with transverse rows of whitish round dots, each bearing a tiny black bristle, the general colour pale green, the subdorsal stripe white, the head green with tiny black hairs, spiracles green, indistinct, the little wart with bristles on 12 as before. The *second moult* comes at the length of 10mm., and after it was passed I noticed the larva had acquired the retractile movement of the head and front segments; the colouring much as before, the wart on 12 now pink, about 0·2mm. high, and set with a few short hairs. The *third moult*, at the length of 20mm., brings the first beginning of the characteristic markings; most of the larvæ remained green, but there appeared a freckling of two tints; the subdorsal stripe was glaucous-green; on this stripe, on segment 5, a spot, round in outline, of three colours, namely, white where the subdorsal line passes, then lilac, and then dark brown in the lower portion; on segment 6 a small white spot on the subdorsal line; the wart on 12 reddish, the subdorsal line runs up to it and ends there. At this moult one larva turned brown—freckled in two tints of brown—subdorsal line dingy buff; the spot on 5 had a reddish centre and a dark brown edge; the small dot on 6 white.

larvæ turned brown; I had not one that showed any trace of the previous green colouring. The fullfed larva was, when walking. 55mm. long, less than 50mm. when at rest, smooth and plump, stoutest at segments 5 and 6, thence tapering very rapidly to the head, which was very small, and with 2 and 3 retractile into 4; segment 12 tapers a little, 13 rapidly; on 12 a small two-pointed wart 0·5mm. high, the skin showing eight not distinct folds in each segment. The colour ashy-brown, freckled with black, the front of each segment being paler and bearing larger freckles, so as to look like a transverse band there; the head ashy; on 2—4 the ground is pale buff, the markings dark brown; a thin dark dorsal line; a buff subdorsal stripe outlined in black; 5 and 6 bear each on the subdorsal level a round spot, that on 5 being the larger; on 5 the spot is lilac with purple-brown centre, on 6 it is paler lilac with brown centre bearing a yellow dot; both these spots are surrounded with strong dark borders, making them very conspicuous. The wart on 12 a little paler than ground, but not conspicuous; the spiracles pale, indistinct; the belly unicolorous, of a pale livid hue with pinkish tinge (Hellins). Buckler figures (*Larvae British Moths*, ii., pl. xxvi., fig. 1 *b*) the fullgrown larva of the green form, also (*loc. cit.*, figs. 1, 1*c*) two fullgrown larvæ of the dark form, and (*loc. cit.*, fig. 1*a*) the larva, before the last moult.

Variation of larva.—The larvæ of this species are green when young, but a very large percentage becomes brown at the 3rd ecdysis, although a few retain their green coloration. Ochsenheimer, in 1808, noticed that adult green larvæ were rare, most being black or blackish-grey. Weismann notes (*Studies in Theory of Descent*, p. 186) that, although he twice reared this species (17 larvæ in all), in no case had he a larva which remained green throughout to maturity, and the green form as adult appears to be rare. Meldola notes (*loc. cit.*, p. 188, footnote) instances of the green form occurring in Surrey, Kent, &c., but they appear to be infrequent. Hellins says that a larva which turned brown at the third moult had the subdorsal line dingy buff. The spot on the 1st abdominal segment had a reddish centre and a dark brown edge; the spot on the following segment white. He also describes the brown form when fullfed (see *suprà*). Buckler figures (*Larvae Brit. Moths*, pl. xxvi., figs. 1 and 1*c*) two very different-looking examples of the brown form.

Development of larval markings.—*First instar:* The larvæ on first hatching measure 3·5mm. in length, are of an uniform light green colour, with a fine white transverse line on the posterior edge of each segment, precisely similar to that which appears in the 2nd stage of *E. elpenor*. They resemble the latter species still further in showing a fine white subdorsal line, which can easily be recognised by the naked eye (fig. 24). Although the adult larva is distinguished from all other known species of *Choerocampa* by the absence of a caudal horn, a distinct but very small one is nevertheless present at this first stage, and is, indeed, retained throughout the entire course of development, but does not increase further in size, and thus, gradually, becomes so small in proportion to the size of the caterpillar that it may be entirely overlooked. The first moult takes place after 4-5 days. *Second*

instar: The blue-green coloration remains unchanged, but a somewhat darker green dorsal line becomes apparent down the middle of the back (the dorsal vessel?), and the subdorsal line now becomes very broad and pure white, being much more conspicuous than in any stage of *E. elpenor* (fig. 25). The tapering of the three front segments occurs at this stage, and oblique dark green striations on a lighter ground stand out distinctly on the spiracles. As with *E. elpenor*, the first traces of the future eye-spots appear during the 2nd stage, not in the present case as a curvature of the subdorsal line, but as a spot-like widening of the latter, of a brighter white than the somewhat greenish colour of the remainder of the line. *Third instar:* After the second moult, the formation of the dark "ground area" *(anteà*, p. 76) of the eye-spots commences by the appearance of a little brown on the under edge of the foremost of the white spots, this coloration gradually increasing in extent and in depth. At the same time both spots become more strongly distinguishable from the subdorsal line, which becomes constantly greener (fig. 27). The brown colour soon passes round the white of the front eye-spot, which becomes so far perfected, whilst the completion of the hind spot is effected slowly afterwards. The formation of the eye-spots does not, therefore, proceed any more rapidly in this species than in *E. elpenor.* At the end of the present stage, the larva is about 4cm. in length; the ground-colour is still sea-green; the subdorsal line is much diminished, completely fading away at its lower edge, but remaining sharply defined above against the green ground-colour (fig. 26). *Fourth instar:* After the 3rd moult all the larvæ (5) became brown, this change occurring, therefore, one stage earlier than is generally the case with *E. elpenor**. In single instances, the brown colour appeared in the 3rd stage. The subdorsal line had disappeared from all the segments but the first three and the last. The eye-spots now rapidly attained complete development; they contained a black pupil, and gave the insect a truly repulsive appearance when, on being threatened by danger, it drew in the front segments and expanded the 4th (fig. 28). The eye-spots of the 5th segment are much less developed than in *E. elpenor;* they remain small and are not readily detected. On the other hand, there now appear on all the segments, with the exception of the last, just as in the 6th stage of *E. elpenor*, distinct rudiments of eye-spots, which present the appearance of irregular, roundish, black spots on the front borders of the segments, at the height of the former subdorsal line. In this latter region, the black pigment is disposed as a longitudinal streak, and, to this, a median line is added, the whole forming a marking which, perhaps, makes the caterpillar appear still more alarming to its foes. This marking is, however, only to be distinctly recognised on the first three segments. The

* This wants carefully comparing with our account of the larva of *E. elpenor* (*anteà*, p. 72), in which it is shown that brown forms of the larva of *E. elpenor* appear in the 4th stadium, as in that of *T. porcellus.* We have already hinted (*anteà*, p. 76) that Weismann stands alone in allowing six larval stadia to *E. elpenor.* Also compare with our description of larva of *T. porcellus* (*anteà*, pp. 100-101), where it is noted that many larvæ of *T. porcellus* do not become dark till the last instar.

"dorsal spots" mentioned in the case of *E. elpenor* then appear very distinctly on segments 5-11. The larvæ continue to feed for 11 days after the 3rd moult, at the end of which period the 4th moult takes place, and the *fifth instar* is assumed, but without the occurrence of any change of marking. The larvæ then buried themselves, the complete development having taken 28-29 days (Weismann).

Comparison of larvæ of Theretra porcellus and Eumorpha elpenor.—In *T. porcellus* the larva emerges from the egg with the subdorsal line, the first stage of *E. elpenor* being omitted. This suggests that the former is the younger species, *i.e.*, has advanced further in development. The subsequent course of development of *T. porcellus* is essentially a repetition of the phenomena displayed by *E. elpenor* and differing only in one point, *viz.*, that all new characters make their appearance one stage earlier than in the latter species. This is the case with the transformation of the green into a brown ground-colour, with the repetition of the eye-spots on the remaining segments in the form of suffused black spots; and with the appearance of the light dorsal spots. Only the eye-spots themselves appear, and the snout-like tapering of the front segments occurs in the same stage as in *E. elpenor*, *i.e.*, the second (Weismann). [Compare *antea*, pp. 76-77. See also footnote p. 102.]

Cocoon.—The cocoon is spun (in confinement) on the surface of the earth under dead and dried bedstraw, is large and irregular in shape, formed of loose and scanty, rather coarse, brown silk, perhaps best described as forming an open network, rather than a cocoon (Bacot); the larvæ make a very open network cocoon on the surface of the earth, working in bits of moss, &c. (Hellins); spins up on the soil under moss or grass a slight cocoon of silk and moss (Lambillion). Adkin gives (*Proc. Sth. Lond. Ent. Soc.*, 1889, p. 153) an interesting note as to a pupal chamber formed by a larva in one of the folds of the leno in which it spun up. The space was lined with a substance resembling a film of gelatine, slightly flexible to the touch and apparently of a damp-resisting nature; he assumed it to represent the lining of the earthen cell, made by larvæ, when pupating under natural conditions, but of so delicate a structure as to prevent its being detected when a pupa is removed from the earth. After the emergence of the imago it was found that the gelatinous lining had almost disappeared.

Pupa.—This pupa is at first sight indistinguishable from that of *E. elpenor* except by size, being 30mm.-38mm. long instead of 35mm. to 45mm., and, on closer examination, the differences are seen to be such that it is obvious that a description of the one without seeing the other might easily apply to both, even if made with some care. It will, therefore, be more satisfactory to describe the pupa of *T. porcellus* by special reference to the points in which it differs from that of *E. elpenor*. As to the form of the pupa, it is at least as little flattened as that of *E. elpenor*. The head is proportionally a little larger, the labrum is thrown a little further back, and the maxillæ in front of it (*i.e.*, ventral to it) project distinctly beyond it, and form the anterior point of the pupa, the eye being directed exactly forward. The proboscis keel is a little sharper and more prominent. The eye-spine terminates,

not in a rounded tubercle but, in a sharp spine curved backwards to form a hook. The labral prominence is less marked. The dimensions are:

Measurements at	Distance from front of pupa.	Transverse diameter at	Antero-posterior diameter at
Eye-spines	1·0mm.	4·3mm.	4·0mm.
Posterior margin of prothorax	4·0 ,,	5·0 ,,	6·0 ,,
Middle mesothorax	9·0 ,,	7·0 ,,	7·0 ,,
End of 1st leg	10·5 ,,	7·4 ,,	7·8 ,,
End of 2nd leg	12·0 ,,	7·8 ,,	8·0 ,,
Widest part 4th abdominal	16·5 ,,	8·0 ,,	8·6 ,,
End of 4th abdominal	18·0 ,,	8·0 ,,	8·2 ,,
Spines 5th abdominal	21·0 ,,	8 5 ,,	8·0 ,,
Spines 6th abdominal	23·5 ,,	7·8 ,,	7·5 ,,
Spines 7th abdominal	26·0 ,,	7·0 ,,	6·0 ,,
At 8th abdominal	28·4 ,,	5·0 ,,	4·5 ,,
At base of spine	31·0 ,,	2·6 ,,	1·2 ,,
Total length	33·4 ,,		

The rows of spines on abdominal segments 5, 6, 7, differ by passing dorsally more to the front of the segment, and breaking up there into more numerous smaller spines. Laterally, the ridge passes straight round the pupa, at some distance behind the spiracles. In *E. elpenor* it seems as if it would like to go through the spiracle, and bends a little in order to pass round behind it. The line is, indeed, broken by the spiracle, in some specimens absolutely, but, in most, a few fine spines exist behind the spiracle. In *T. porcellus*, except a little bend in the ridge on 7th segment, the spiracle does not enter into the question. The anal spine seems to be the same in both, unless in *T. porcellus* the dorsum be more rounded, as one surface, instead of almost divided into an anterior flat and posterior sloping surface as in *E. elpenor*. The wings are much more distinctly and neatly marked than in *E. elpenor*. Poulton's line is crisply marked by special wrinkling beyond it. In *E. elpenor* the surface beyond is smoother. The nervures are often (there is a good deal of variation) well marked by broad pale lines between darker spaces and with rows of dark dots down them, nervure 8 being almost lost in the costa. There is no scar of caudal horn, except, in one specimen, a depression, which may be accidental. The absence of horn scar is notable, as it exists both in *Pterogon proserpina* and *Thaumus vespertilio*, the only pupæ I have of Sphinges that I know to have hornless larvæ. The sculpturing is wrinkling throughout; there is no pitting; on the 8th abdominal there is well-marked transverse wrinkling (cerebral pattern) and on 9th there is fine longitudinal wrinkling (dorsally). The pitting of anal spike is much as in *E. elpenor*. The subsegmentation seems to be identical. When we examine the pupa-skin microscopically, the differences between *T. porcellus* and *E. elpenor* take at first view a different aspect, in that *porcellus* seems to the naked eye to be wrinkled throughout, *E. elpenor* to be only or chiefly pitted, on 8th, 9th, and 10th abdominal segments. Microscopically, the dark circles which we may call pits or hair-points are much more numerous on these segments in *T. porcellus* than in *E. elpenor*. In *E. elpenor*

they are, however, clear and distinct, and the intermediate surface is fairly smooth, in *T. porcellus* all of them have little grooves passing across their posterior margins, irregularly, but, in the main, in the direction of round the segment, and very few of them have anything at all distinctly like a hair. The spines on abdominal segments 5, 6, and 7 are also somewhat different. In *E. elpenor* they are fairly smooth, with fine wrinkles starting in all directions from their bases, in *T. porcellus* only the tip of the spine is smooth, and the ridges run a long way up the spine. If one can be got at an angle that obscures its curvature, it looks like a volcano, with a smooth sharp apex, but with its sides scored with gullies running out into the plain below. The way in which these graduate into ordinary hair-points, and in which the hair-points form nuclei or centres for the wrinkling, and, finally (at other points), leave the wrinkling more or less undisturbed by them, but with an intermixture of actual hairs, makes a very varied and complicated graduation of structure most interesting to look at, but quite impossible to deal with without elaborate figures (Chapman). ♂ (three measured). 1·2ins.—1·25ins. in length, width just over ·3in. Cylindrical, thickest at 4th abdominal segment; tapering gradually to either end; the pupal envelope stout, surface rather dull, due to wrinklings and corrugations of skin (although these are themselves smooth and shiny when seen with a lens, the effect as a whole is to produce a dull surface). Colour light wainscot or flesh-brown, mottled and striped with dark brown, almost black (one pupa much lighter than the two others); the wing-cases dark, nervures pale; antennæ and maxillæ dark, legs pale; eyes and headpiece dorsally dark and prominent; the greater part of dorsal area dark; cremastral spike black. The head very prominent; maxillæ large, projecting in a keel-like process at top, but tapering to a narrow double sheath which is continued to end of wing-cases; antennæ and legs short; the great development of maxillæ has apparently forced the labrum and other usually ventral head-parts into a dorsal position. The prothorax small; the mesothorax large; the metathorax small; the 1st abdominal segment short, the 2nd longer; the 3rd twice the length of the 1st, and the 4th at least four times the length of 1st; the 5th nearly as long, the 6th slightly smaller; the 7th still narrower, and fused to the 8th. The cremaster is broad, laterally very rough, convex on dorsal surface, concave on ventral; it narrows rapidly to a sharp polished spine curved in a ventral direction. The spiracles are distinct, large, forming rather long and narrow slits with the skin much wrinkled around them. On the dorsal and lateral areas of the 5th, 6th and 7th abdominal segments, at or near the middle of segment, but passing behind the spiracle and curving towards the anterior edge near the median line, is a low ridge of stout sharp conical spines, slightly curved towards anal end of pupa; in the middle of dorsal area where the line curves towards the anterior margin of segment, the ridge is somewhat broken up and the spines, which are scattered over a band, are also smaller. [This character is well-developed in the pupa of *E. elpenor*, but the spines are more numerous and do not form so well-marked a ridge, but rather a band, and the spiracle is placed directly in their line, forcing the spines, which are much smaller hereabouts, out in a curve behind the spiracle.] A band along the

posterior edges of the 4th, 5th and 6th abdominal segments is finely and regularly granulated, giving a comparatively smooth border to segment (Bacot, October 23rd, 1898). The pupa is rather over 30mm. in length, cylindrical, the headpiece sloping from the shoulders, and with rather prominent eyes and a projecting keel for the tongue-case, the wing-cases short, figure stoutest about middle, tapering either way, the rough anal spike triangular, flattened, and hollowed somewhat, ending in a sharp point, the skin rather rough. On the three abdominal segments next below the wings is a line of small projecting points passing almost round the body; the colour dusky ochreous, much freckled with black, the wing-cases smoky (in some examples the nervures are marked out in black), a blackish dorsal line, and the abdominal segments well marked with black rings (Hellins, November 5th, 1886). The pupal skin is rough and wrinkled, except the black incisional areas between the movable segments which are almost smooth, glossy, and have the appearance of silk. Colour brownish, with a fine black mediodorsal line and black shading running subdorsally down the thoracic and 1st abdominal segments; the black is confined to a posterior subsegmental ring on the 4th, 5th and 6th abdominal segments. The head is prominent, the base of the maxillæ enlarged, ridged (upper part of maxillæ have appearance of being coiled), the tip extending just beyond the apices of the wings on the posterior edge of the 4th abdominal segment, two ill-developed structures (resembling nosehorns) project over glazed eye; the antennæ commence at front edge of prothorax, run ventrally between glazed eye and the distinct prothoracic spiracle; the latter situated on intersegmental line between pro- and mesothorax; the antennæ, strongly segmented, extend about half-way along costa of forewing; two pairs of legs, pale-coloured, on each side of maxillæ; the wings narrow, the inner margin somewhat hollowed. The prothorax narrow, the mesothorax strongly developed, the metathorax narrow; the abdominal segments increasing in size from 1st to 4th (which is very wide), the 5th and 6th also wide; movable incisions between 4-5, 5-6, 6-7; on the 5th, 6th and 7th abdominal segments, a prominent reddish ring, the edge thickly studded with short black points; the ring, least developed on dorsum and venter, runs obliquely back from front of each segment dorsally to behind the spiracles laterally; the spiracles black, elongate, ear-shaped, that on 1st abdominal segment partly hidden beneath wing, that on 8th abdominal obsolete; on the venter of abdominal segments 3-6 are traces of position of prolegs; the terminal segments tend to obsolescence; the body terminated by a pointed, corneous, cremastral horn, turned downwards, and with a wide flattened base (Tutt).

Comparison of pupæ of Theretra porcellus and Eumorpha elpenor.—The pupæ of *T. porcellus* are proportionally longer and more slender than those of *E. elpenor*, that of the former averaging 1·25ins. long and just over ·32ins. in width, the latter 1·5ins. long and just under ·34ins. in width; the keel-like maxillæ rather more prominent in *T. porcellus* than *E. elpenor*. The cremaster of the former similar to that of the latter but rather larger in proportion (Bacot).

Parasites.—*Ichneumon fusorius*, Wesm. (Harwood), *Amblyteles fuscipennis*, Wesm. (Bignell), *Trogus exaltatorius*, Panz., *Anomalon*

cylindricum, Bridg., *Banchus moniliatus*, Gr., *B. falcator*, Fab. (Adkin *teste* Bignell), *Trogus lutorius*, Fab. (Billups), *T. alboguttatus* Gr. (Billups).

FOODPLANTS.—*Epilobium*, [*Impatiens*] (Linné), *Galium verum*, *G. mollugo*, *G. palustre* (Buckler), *G. saxatile* (Chappell), *G. aparine* (Robson), *Epilobium angustifolium* (Standish), *E. hirsutum*, *Lythrum salicaria*, *Vitis vinifera* (Kaltenbach).

HABITS.—The imagines are occasionally to be found at rest on various plants—frequently found on banks covered with *Ononis arvensis* on the Lancashire coast sandhills (Moss), abundant in 1895 along foot of North Downs near Wye, especially on the old racecourse; they were mostly seen at rest on bedstraw and grass (Theobald), five taken at rest on *Galium* growing at roots of rushes on Wimbledon Common (T. Briggs), on the steep grassy side of the slope above Blair Logie on June 6th, newly emerged (Wingate), at rest in the long grass at Beachy Head (Blenkarn), at rest on grass, June 8th, 1900, at Orton (Thwaytes), a pair taken *in copulâ* at 1 a.m., on June 19th, 1891, at Dublin, the specimens on the head of a tall stalk of grass, their brilliant colour attracting attention (Curzon); at rest on a nettle about 10.45 a.m. at Tuddenham on June 18th, 1891 (Christy). They rarely come to light in Britain, but there are some records—at Taunton in 1886 (Farrant), in August at Wallasey (Powley), at Winchester (Shepheard-Walwyn), at Appledore (Heitland), on lamps at Worcester (Rea), on the continent it is often recorded at light, *e.g.*, at Namur the imagines often come to light (Lambillion), common at electric light at Berne from April 12th—August 15th, 1893 (Hiltbold), at electric light at Aigle on July 3rd-4th, 1898 (Lowe), common at electric light at Zürich in May and June, 1893-5 (Nägeli), abundant at electric light July and August, 1896, at Aix-les-Bains (Agassiz). It comes somewhat freely on some occasions to sugar — at Winchester, in June, 1891, a specimen rushed like a hawk at the brush as it was taken out of the pot to sugar a tree and began feeding (Hewett), odd ones now and again at sugar at Lincoln (Musham), hovering at sugar in the New Forest at dusk (Lofthouse), at sugar at Wheatley Wood (Corbett), at sugar from June 12th-16th, 1871, at Sherwood Wood (Porritt), at Deal, as soon as the sugar was put on (Carr), &c. Its natural habit, however, is to visit flowers from just before dusk and to remain on the wing rather more than a couple of hours, from about 8 p.m. until 10.30 p.m., though few come after 10 p.m. At Namur the moths fly regularly about 9 p.m. at *Galium* (Lambillion), at 9 p.m. at bugloss, continuing on the wing only for about an hour (Poulton), at St. Ives at honeysuckle, rarely later than 8 p.m., best time half an hour earlier, very abundant in 1879, a dozen being captured on each of six successive evenings (Norris), flies just before dusk at Biedenkopf (Rühl), hovering over honeysuckle just between daylight and dusk from June 1st-9th, 1894, at Windrush Burford (Todd); commences its flight about 8.30 p.m. at Painswick (Watkins). It chooses a large variety of flowers for its visits—*Silene inflata* at Hartlepool (Merryweather), abundant at pinks in 1895, at Coxhorne and Charlton Kings (Robertson), and at Bremhill (Eddrup), red campion in North Wales (Woodforde),

at Atherstone (Baker), and at Horrabridge (Still), white campion at Market Drayton (Freer), valerian and white pinks at Sulby (Clarke), ragged robin at Legsby (Raynor), *Echium vulgare* at St Margaret's Bay (Reid); at *Saponaria officinalis* on the banks of the Lahn (Jäger), common rocket and vetches, unusually abundant in 1888, at Sligo (Russ), honeysuckle and verbenas at Haynes Park (*Int.*, 1, 198), sweetwilliams at Whittlesford (Thurnall), *Centranthus* at Bury St. Edmunds (Norgate), yellow iris at Wallasey (Cooke), and on the Carnarvon coast (Johnson), azaleas at Corsemalzie (Gordon), at red valerian at Rugeley (Freer), at Mucking (Burrows), and at Lynmouth (Briggs), at honeysuckle at Church Stretton (Newnham), at St. Ives (Norris), at Howth (Birchall), at Stonehouse, very abundant in 1896 (Nash), at Castle Cosey, abundant in 1896 (Thornhill), at Ladylaw (Guthrie), at Worcester (Rea), at Chiswick (Sich), and at Mansfield (Daws), at rhododendrons at Church Stretton (Newnham), at Hayes (Fuller), at Wishanger (Bingham-Newland), &c. Many other records at rhododendron, honeysuckle and valerian show these to be the favourite flowers for attracting the species in this country.

HABITAT.—Appears to be generally distributed on coast sandhills, on chalkhills, cliffs, downs, in meadows, and occasionally by ditchsides, &c., but appears to prefer dry situations, the imagines also abundant near woods, in gardens, &c. Jäger notes it as abounding on the banks of the Lahn, Moss observes it as being common on the borders of the large flat tracts of moss land in Westmorland where it is always associated with *Galium mollugo* growing in thick patches among the grass especially at the sides of dykes, but such localities are apparently not often chosen. It abounds on the coast sandhills of Sligo, Montrose, Aberdeen, Durham, Wallasey, &c., on the shingle quite close to the sea at Deal and Kingsdown, on the seabanks on both sides of the Tyne, on the chalk downs at Wye, Cuxton, &c., in pasture meadows at Freshwater, on the chalk cliffs at Dover, Folkestone, &c., on the steep grassy slopes above Blair Logie, &c. Such a variety of situations naturally betokens a very wide distribution, and this the species undoubtedly has in our Islands. Abroad its habitats are even more varied. It occurs in the Pyrenees to a height of 6000ft., and in the barren steppe districts of Orenburg and Sarepta.

TIME OF APPEARANCE.—There is no evidence that this species is even partially double-brooded in this country although it is frequently so in various parts of southern Europe. In central Europe, however, it is single-brooded as in the British Islands. It is also very uncertain in appearance, in some years, *e.g.*, 1868, 1879, 1888, 1895, 1896, it is abundant, in others quite rare. It also appeared in great numbers in 1875 and 1886 in certain parts of Germany. Its times of appearance have been noted as follows: May, in Istria, in the dept Doubs, one as early as April 22nd, 1842, near St Vit; middle of May, near Rome, at Nantes, and at Brussa; May and June at Eutin, Brunswick, Halle-a-S., Saxon Upper Lusatia, Augsburg, Epiries, Rosenau, in the Inn Valleys, in the lowlands of Switzerland, in the Ural district, Transcaucasia, and the Netherlands; in June at Bremen, Crefeld, Cassel and Wiesbaden; in June and July in Roumania; commencement of

July in Bucovina; middle of July in Transsylvania; July and August in Alsace, and at Aix-les-Bains, &c. The following suggest double broods; middle of April to commencement of June, and again in July and August at Budapest (*teste* Bartel), May and September in Tuscany (*teste* Bartel), April and May and sometimes in July in the Haute-Garonne (Caradja), May-June and again in July-August in Baden, May-June and August-September at Constance, May and July at Fünfkirchen (Reutti), June and August in the Gironde (Trimoulet), mid-May to July at Waldeck, sometimes again in September (Speyer), only singly in June, 1892, at the electric lights, but much commoner in August, 1892, at Berne (Benteli), throughout the summer, from April 12th-August 15th, 1893, at Berne (Hiltbold), Fritsch gives dates for Austro-Hungary from May 12th-July 15th, also from Salzburg on July 17th, 29th, August 10th and September 12th. In the Channel Islands we have: July 9th, 1860, July 9th, 1887, April to June, 1897, in Alderney (Walker), July 29th, 1860, in Jersey (Johnson). The following actual dates of captures have accumulated: May 28th, 1743, several in Osterly Wood, near Brentford (Wilkes), imagines July 18th, 19th, 20th, 21st, 1846, at Brighton (The Level) (Merrifield), June 18th, 1856, June 14th, 1859, at Hollingbury Coombe, June 23rd, 1898, on Putney Heath (Image), common July, 1856, at Haynes Park (*Int.*, i., p. 198), June 11th-15th, 1858, at Worcester, June 15th-25th, 1860, June 7th, 1865, at Worcester, ♀ just emerged, 135 oval green eggs taken from her, all fully mature (Edmunds), June 10th, 1859, and following days, at Oundle (Whall), June 15th, 1859, July 13th-15th on Wimbledon Common, June, 1890, at Folkestone, June 26th-July 1st, 1899, at Lynmouth (T. Briggs), June 29th, 1859, and following days, common at Perth (White), July 1st-7th, 1859, at Leckhampton (Trye), June, 1860, at Galway (Ellis), bred from larvæ found at Deal, June 18th, 1861, also June 25th, 1875, at Dartford (Fenn), June 1st-9th, 1864, at Windrush Burford, June 16th, 1866, at Northleach (Todd), June 6th-9th, 1864, at Chertsey (A. H. Clarke), imagines bred from pupæ June 16th, 1867, July 1st-7th, 1886, at Emsworth (Hellins), May 26th, 1868, at Guestling (Bloomfield), June 12th-17th, 1868, common at Howth (Birchall), June 13th, 1868, at Ashford (Jeffrey), 3 imagines last week in July, 1868, near Tynemouth (Bold), June 5th-26th, 1869, in New Forest (Capper), June 29th, 1869, at Leyton (Meldola), unusually common at Folkestone, July, 1869 (Standish), July, 1869, at Wallasey (Melvill), June 13th, 1870, June 12th, 1890, and following days at sugar at Witherslack, June 12th-16th, 1871, at Sherwood Wood, near Exeter (Porritt), June, 1870, worn, at Douglas (Robinson), July 6th, 1871, two near Ballinasloe (Lawless), June 23rd-July 21st, 1873, in New Forest (Tugwell), unusually abundant in May, 1882, at Culleenamore (Russ), June 28th, 1884, at Luffness Links (Evans), June, 1885, pretty abundant at St. Ives (Norris), June 10th, 1885, at Brentwood, June 30th, 1894, at Rainham and June 7th-20th, 1901, at Mucking (Burrows), June 11th, 1885, at Brentwood, June 20th, 1895, at Legsby, June 17th, 1898, at Galley Wood (Raynor), July 1st, 1886, June 27th-July 12th, 1887, June 19th-July 12th, 1888, June 17th, 1889, June 22nd, 1891, June 8th-20th, 1892, June 15th, 1894, June 26th, 1895, June 5th,

1896, July 3rd, 1897, at Emsworth, June 18th, 1891, at Tuddenham (Christy), June 4th, 1887, at Loughton, June 11th, 1887, at Theydon Bois (Oldham), a pair on June 21st, 1887, at Cheddar (Bath) [one bred January 28th, 1889, from a forced pupa from Kingsdown (Tugwell)], netted June 1st-4th, 1889, June 1st-18th, 1890, at Portland (Brown), June 11th-18th, 1890, at Swansea (Robertson), captured at Norwood June 15th-July 11th, 1890 (Swain), June 18th, 1890, on moor at Paul, June 20th, 21st and 22nd, 1890, in garden at Mansfield, June 18th, 1899, at Redhouse Downs (Daws), imago bred July, 1890, from larva found at Potter's Bar (Mera), July 14th, 1890, captured at Sandown, June 13th, 1896, at Oxshott (Prout), June, 1891, June, 1899, at Lewes (Nicholson), June, 1891, at Winchester (Hewett), June 19th, 1891, at Dublin (Curzon), May, 1893, at Oxhey (Brown), May, 1893, at Wheatley Wood (Corbett), June 9th, 1894, at Galway (Allen), June 23rd-July, 1894, at Hythe (Adkin), May 27th-June 6th, 1895, May 28th-June 13th, 1896, June 17th, 1897, June 6th-30th, 1898, June 4th-12th, then one on July 14th, 1901, earliest in 1902 seen on June 20th, at Skipwith (Ash), May 31st-June 7th, 1895, June 4th-14th, 1897, common, May 21st-June 6th, 1899, June 3rd-20th, 1900, at Sulby (Shortridge-Clarke), imagines abundant June, 1895, near Wye (Theobald), throughout May, 1895, also June 17th, 1895, and following days, abundant at St. Cyrus, near Montrose (Gunning), imago netted at Oxted, June, 1895 (Sheldon), June 1st-4th, 1895, in north Staffs (Blagg), June 3rd, 1895, at Hayes (Fuller), June 15th, 1895, in the Quantock Hills, June 25th, 1895, at Newquay (Watts), May 28th, 1896, June 26th, 1897, July 4th, 1898, June 16th, 1899, not uncommon at Rugeley, June 20th-July 10th, 1900, at Anglesea, very common (Freer), May 28th, 1896, and on into early June at Church Stretton (Newnham), June 4th-8th, 1896, at Castle Cosey (Thornhill), three taken at Corsemalzie on June 10th and 11th, 1896 (Gordon), June 13th, 1896, imago at rest at Oxshott (Lovis), June 15th, 1896, July 3rd and 21st, 1898, at Worcester (Rea), June 16th, 1896, at Wannock, June 19th, 1896, at Peterborough (Pearson), bred June 19th, 1896 (Glenny), June, 1897, at Okehampton (Bland), June 6th, 1897, at Loughton (McIntyre), June 10th, 20th, 27th, 29th, 30th, July 1st, 2nd, 3rd, 6th, 1897, June 23rd, 29th, 30th, July 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 12th, 13th, 1898, all at Boxworth (Thornhill), ♀ captured July 2nd, 1897, laid a few ova, these hatched in 12 days, larvæ fullfed about August 20th, began to emerge June 19th, 1898, June 9th-21st, 1901, at Reigate (Prideaux), July 4th, 1897, July 6th, 1899, at Reading, July 12th, 1898, several captured at Folkestone (Butler), [forced from October 20th, 1897, one emerged December 6th, 1897, another January 14th, 1898=3 months at from 115°F. daytime, to 50°F. at night (Moss),] June 8th, 9th, 11th, 17th and July 2nd, 1898, June 11th, 15th, 24th, 1899, at Chelmsford (Miller), June 26th-30th, 1898, between Waxham and Horsey (Cox), March 20th, 1899, a freshly emerged specimen in a garden at Limpsfield (Shepheard-Walwyn), June 12th-19th, 1899, at Atherstone (Baker), June 24th, 1899, at Ayr (Wilson), several fullfed larvæ found in the Isle of Man on September 13th, 1899, these duly pupated, the imagines appearing June, 1900 (Clarke), June 1st-13th, 1900, in N. Wales (Woodforde), June 6th, 1900, at Lincoln (Musham), June 9th-14th, 1900, at Darenth (Barraud), imagines emerged June 13th-14th, 1900,

from larvæ found at Benfleet on July 17th, 1899 (Whittle), June 8th, 1900, at Orton, June 8th, 1901, at Carlisle (Thwaytes), June 15th, 1900, at Lichfield (Redmayne), June 20th, 1900, at Hartley Links (Rosie), June 23rd, 1900, from pupa found at Dorking (Oldaker), June 29th, 1900, at Beachy Head (Blenkarn), one taken June 28th, 1900, at Bremhill (Eddrup), imagines abundant, July, 1900, at St. Margaret's Bay (Reid), July 17th, 1900, at Hull (Haworth-Booth), May 12th, 1901, at Hampstead (Hopson), June 15th, 1901, at Chathill (Allhusen), June 23rd, 1901, at Arbrook Common (Fleet), June 26th, 1901, bred at Scarborough (Head), June 25th-30th, 1902, at Deal (Carr), June 18th-July 1st, 1902, in New Forest (Lofthouse).

LOCALITIES.—Widely distributed throughout England, Scotland and Wales (Tutt), distributed throughout Ireland and fairly numerous in some localities (Kane). ABERDEEN: coast districts (Esson), Aberdeen (Reid), Inverurie (Tait). ANGLESEA: Holyhead (Freer). AYR: Irvine, common, Lendalfoot (Dalglish), Ayr (Wilson), Cloncaird Castle (Anderson), Girvan (Rose), Monkton (Duncan), Troon (Evans). BEDFORD: Bedford (Steuart), Haynes Park (*Int.*, i., p. 198). BERKS: Reading (Butler), Burghfield, Pangbourne, Streatley (Holland), BUCKS: Wavendon, Halton (Stainton). CAMBRIDGE: near Cambridge (Farren), Whittlesea (Bond), Whittlesford, common (Thurnall), Boxworth (Thornhill), Wicken (Christy). CARMARTHEN: Carmarthen (Tutt coll.), Langharne (Kaye). CARNARVON: Abersoch (G. O. Day), Deganwy (Gardner), Tan-y-Bwlch dist. (Arkle). CHESHIRE: more frequent along the coast (Ellis), Delamere Forest and East Cheshire (Walker), Wallasey sandhills (Cooke), West Kirby (Pierce), Tarporley (Stock), Bowdon, Knutsford (G. O. Day), Birkenhead, New Brighton (Almond), sandhills between New Brighton and West Kirby (Moss). CLARE: Ennis and East Clare (Stacpole), Bally Vaughan (Kane). CORK: Harbour View, near Timoleague, Courtmacsherry, common (Donovan), coast districts—Queenstown, Glengarriff (Kane). CORNWALL: Redhouse Downs, Paul, Penzance (Daws), Newquay (Watts). CUMBERLAND: rare, mostly captured on coast (Day), Maryport, common (Swainson), Castle Carrock (Bowman), Cockermouth (Robinson), Flimby coast and Flimby Wood (Mawson), Keswick, rare (Beadle), Lake district (Stainton), Workington (Wilkinson), Orton (Thwaytes), Carlisle (Armstrong). DENBIGH: Chirk (Gardner), Denbigh (Walker). DERBY: Willington district, Derby, rare (Pullen). DEVON: Lynmouth (T. Briggs), Ilfracombe (Henderson), Westward Ho (Gosset), Sherwood Wood, near Exeter (Porritt), Dartmoor (Gummer), Teignmouth (Rogers), Okehampton (Bland), Horrabridge (Still), Plymouth (Stainton). DONEGAL: Donegal (Kane). DORSET: Portland, not uncommon (Richardson), Rempstone (Bankes), near Gussage (Stephens), Swanage (Freeman), Blandford (Stainton). DUBLIN: Malahide (Bristow), Kingstown, Killiney, Larnhay Island (Kane), Blackrock (Greer), Howth (Birchall), Dublin (Curzon). DURHAM: not rare on coast (Robson), Hartlepoo (Merryweather), South Shields (Eales), Seaton Carew (Backhouse), Jesmond (Henderson). EDINBURGH: Tyne Mouth, Luffness Links (Evans), Edinburgh (Jenner-Fust). ESSEX: on the coast (Harwood), Saffron Walden (Jeffrey), Wanstead, Brentwood, Rainham (Burrows), Chelmsford (Miller), Galleywood (Raynor), Forest Gate (Mera), Eastwood (Vaughan), Theydon, Loughton, Lords Bushes (Oldham), Maldon (Fitch), Leyton (Meldola), Benfleet (Whittle), Sudbury district, rare (Ransom), Chingford (Latchford), Epping (Stainton). FIFESHIRE: Crail, Pettycur, Kinghorn (Evans). FLINT: Rhyl (Gardner). FORFAR: St. Cyrus, Montrose (Gunning). GALWAY: central and eastern parts of county not scarce, Ardrahan, &c (Kane), Galway (Allen), Clonbrock (Dillon), Claring Bridge, near Galway (Birchall), Ballinasloe (Lawless). GLAMORGAN: Swansea district, common, Sketty Park (Robertson). GLOUCESTER: Tewkesbury district, sometimes common (Fox), Forest of Dean (Searancke), Painswick (Walker), Stonehouse (Nash), Cheltenham (Standish), Windrush Burford, Northleach (Todd), Uley (Fitzgerald), Leckhampton (Trye), Charlton Kings, Coxhorne (Robertson), Tuffley (Rea), Cotham, near Bristol (Crawford), Clifton Downs, Stapleton, scarce, Westbury (Hudd), Redland (Vaughan), Cirencester (Harman), Bristol (Stainton). HADDINGTON: North Berwick, Gullane, Longniddry (Evans). HANTS: Winchester, Crabbe Wood: not uncommon (Fisher), Isle of Wight — Freshwater (Sheldon), Sandown (Prout), Wishanger, Headley (Bingham-Newland), New Forest (Cox), Gosport, Portsea Island, fairly common (Pearce), Burghclere dist. (Alderson), near Emsworth (Christy), Hartley

Row (Holland), Bisterne (*Subs.*, p. 20), Basingstoke (Holdaway), Christchurch (Adye). HEREFORD: Leominster (Hutchinson), Tarrington (Wood). HERTS: Hitchin (Griffith), Broxbourne (Bacot), Bushey Heath (Barraud). HUNTS: St Ives (Norris). ISLE OF MAN: Sulby, Ramsey, Douglas, Ballaugh Curraughs (Shortridge-Clarke). KENT: Tunbridge Wells (Henderson), Ashford (Brackenbury), Dover (Walker), Ramsgate (Willson), Folkestone (Fellows), North Downs, near Wye (Theobald), Deal (Meek), Appledore (Heitland), Hayes (Fuller), Hythe (Adkin), Darenth (Barraud), St. Margaret's Bay (Reid), Tenterden (Stainton). KINCARDINE: coast districts (Esson). KIRKCUDBRIGHT: Douglas (Robinson). LANCS: more frequent along the coastline (Ellis), Southport, Morecambe Bay (Murray), Crosby sandhills (Harker), Lytham (Hodgkinson), near Manchester (Buxton), Patricroft, Dunham Park (Chappell), Grange-over-Sands (Booth), Preston (Stainton), sandhills between Waterloo and Formby (Moss). LEICESTER: Gumley, not common (Matthews), Buddon Wood (Headly), Blackbrook (Vice). LINCOLN: Hartsholme (Carr), Ranceby (Stow), Market Rasen district (Lewington), Grantham (Walpole), Panton, Newball, Legsby (Fowler), Lincoln (Mackonochie), Humber district (Ash), Great Grimsby (Dawson), Cleethorpes (Auld). LOUTH: Castle Bellingham (Thornhill). MERIONETH: Dinas Mawddwy (Tetley), Barmouth (Arkle). MIDDLESEX: Harrow Weald, Oxhey (Rowland-Brown), Mill Hill, Hendon (South), Hampstead (Hopson), Hounslow (Powley), Potters Bar (Mera), Waltham Cross, Enfield (Bowles), Chiswick (Sich). MONAGHAN: Drumreaske (Kane). MONMOUTH: Llandogo (Nesbitt). NORFOLK: The Broads—Waxham and Horsey (Cox), Cromer (Russell), Yarmouth district (Moss). NORTHAMPTON: Peterborough (Pearson), Northampton (Quail), Sherwood (Daltry), Oundle (Whall). NORTHUMBERLAND: not rare on coast, Twizell (Robson), Hartley Links (Rosie), Bambro' (Brady), Blyth Links, Whitley (Maling), Chathill (Allhusen), St. Mary's Island, near Tynemouth (Bold). NOTTINGHAM: Mansfield (Daws). OXFORD: near Goring, Hardwick, Southstoke (Holland), Oxford (Steuart). PERTH: common in the lowlands, rare or absent in the highlands—Forth, Earn, Gowrie and Perth districts (F. B. White), Almondbank (Tutt coll.), Dumyot, above Blair Logie (Wingate). ROXBURGH: Caverton district (Elliot), Hawick district—Ladylaw, Wilton Dean (Guthrie). SHROPSHIRE: Church Stretton (Newnham), Wyre Forest (Rossiter), Market Drayton (Woodforde). SLIGO: coast districts, Markree Castle, Ballysodare, Lough Gill (Kane), Culleenamore, Sligo (Russ). SOMERSET: Quantock Hills (Watts), Brislington (Ficklin), Weston-super-Mare (Crotch), Cheddar (Bath), Taunton (Farrant), Clevedon (Mason), Wotton-under-Edge (Perkins). STAFFORD: north Staffs, rare (Daltry), Stoke-upon-Trent (Earl), Burnt Woods (Blagg), Market Drayton district (Woodforde), Rugeley, Cannock Chase, fairly common (Freer), Lichfield (Redmayne). STIRLING: Bridge of Allan (Wingate). SUFFOLK: not uncommon in sandy districts — Brandon, Tuddenham (Needham), Ipswich (Platten), Bury St. Edmunds (Norgate), Sudbury district, rare (Ransom), Aldborough, Bungay (Bloomfield), Stowmarket (Stainton). SURREY: Riddlesdown, Boxhill (Sheldon), Barnes (Sich), Putney Heath (Image), Wimbledon (T. Briggs), Limpsfield (Shepheard-Walwyn), Camberley (Watson), Reigate (Prideaux), Arbrook Common (Fleet), Croydon (Tugwell), Wallington (Robinson), Oxshott (Prout), Coombe Wood, Wandsworth Common (Stephens), Chiswick (Mitchell), Chertsey (Clarke), Haslemere (Barrett), Esher (Lovis). SUSSEX: not common—Lewes, Guestling, rare (Jenner), Brighton, common (Edwards), on the South Downs (Fletcher), Eastbourne (Adkin), Hailsham (Carr), Beachy Head (Blenkarn), Hastings (Butler), Hollingbury Coombe, Rottingdean (Image), near Emsworth (Christy), Wannock (Pearson). WARWICK: Sutton, near Birmingham (Tye), Atherstone (Baker), Northfield (Wynn). WATERFORD: Tramore, Minehead, Waterford, Dunmore (Kane). WESTMEATH: Cromlyn (Battersby), Lakes of Derravaragh and Belvidere, Killyon (Reynell), Mullingar (Middleton). WESTMORLAND: Witherslack (Porritt), Kendal district, Underbarrow, Bregsteer, Meathop, Holkar (Moss), Ambleside (Buckton), Burton (Murray). WIGTOWN: Corsemalzie (Gordon). WILTS: Winterslow, near Salisbury (Stephens), Salisbury (Neale). WORCESTER: generally common—Worcester (Rea), Wyre Forest (Bradley), Malvern Links (Smith). YORKS: not uncommon in eastern division of county, apparently rare elsewhere (Porritt), Skipwith (Ash), Fulford (Hewett), Hullbank (Bolt), Wheatley Wood, near Doncaster (Corbett), Whitby (Bold), Everingham (Sumner), Hull (Hayworth), Scarborough (Head), Huddersfield (Varley), Spurn, abundant (Lawton), near York (Prest).

DISTRIBUTION.—Throughout Europe, extending into Asia Minor, and, according to Young, reaching into the Punjaub; it is also recorded from the

Kouldja district by Alphéraky, and from the high mountains east of Siwas, Tokat and Amasia, but Staudinger queries its occurrence here. Its extension into Asia, therefore, appears to be somewhat limited. In Africa it appears only to have been recorded from Egypt. AFRICA: Egypt (Blomer). ASIA: north-western Asia Minor—Brussa, Olympus, Smyrna, Turbaly, Bos-Dagh (Staudinger), north-eastern Asia Minor—Cilicia, in the high mountains east of Siwas, Tokat and Amasia (Lederer), Kouldja district (Alphéraky), Punjaub, common (Young). AUSTRO-HUNGARY: Upper Inn valleys—Pöstlingberg, &c. (Himsl), Innsbruck, Taufers Valley (Weiler), Tyrol, lowlands, rare (Hinterwaldner), Bruneck, in Puster-Thal at 2600ft., Bozen, Trient (*teste* Bartel), Carinthia — Pörtschach (Wagner), Istria - near Volosca, Carniola—Nanos (*teste* Bartel), Bukovina (Hormuzaki), Pressburg (Rozsay), Bohemia (Nickerl), Trier, Augsburg, Schnee-berg, Wippach, Budapest (Speyer), Galicia, sparingly—Lemberg, Brody, &c. (Garbowski), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Schneider), Bregenz, Freistadt, Iglau, Kaschau, Neutitschein, Rosenau, Troppau (Fritsch), Hermannstadt (Czekelius), Epiries (Husz), Hungary, not rare—Kocsocz (Vangel), Gölnitz (Hudák), Glockner (Mann), Salzburg, Moellthal (Nickerl), Lavantthal (Höfner), Upper Styria—St. Lambrecht (Kodermann), Lower Austria —Vienna, &c., Moravia — Mährisch-Trubau, Ungarisch-Brod, Hungary, every-where, not rare—Klepacs, Comitat Neutra, Ungarisch-Altenburg, Raab, Heveser and Zipser Comitat, Tihuczán, Transsylvania, Fünfkirchen, Josefsthal, Croatia (*teste* Bartel). BELGIUM: Namur, Dinant, Liège, Huy (Lambillion), Condroz, &c., Ardennes, common, Hesbaye, rare, Louvain, Brussels (Donckier). BULGARIA: Kuru Baglar, one only (Bachmetjew). CHANNEL ISLANDS: Alderney (Walker), Jersey (Johnson). DENMARK: fairly common — Zea-land Island, &c. (Bang-Haas). FINLAND: southern and eastern districts (Zetter-stedt). FRANCE: not rare (Berce), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir (Guenée), Haute-Garonne (Caradja), Paris, Meuse, Moselle and Meurthe districts, Bordeaux (Speyer), Puy-de-Dôme (Guillemot), Var (Cantener), Morbihan (Griffith), Gironde (Trimoulet), Doubs—St. Vit (Bruand), Aude (Mabille), Loire-Inférieure—Nantes (Bonjour), Saone-et-Loire (Constant), Seine-Inférieure, rather rare (Viret), St. Quentin (Dubus), Deux-Sèvres (Maillard), dept. Indre, common (Martin), French Pyrenees — Pic du Midi de Bigorre at 6000ft. (Jones), Aix-les-Bains, common (Agassiz). GERMANY: everywhere (Heinemann), northwest Germany, generally distributed (Jordan), Rhine Palatinate (Bertram), Würtem-berg—Stuttgart (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmer-mann), Waldeck — near Wildungen, rather common, Arolsen, Rhoden, rare (Speyer), Upper Hartz (Hoffmann), Zeitz-on-the-Elster (Wilde), Halle—near Nietleben, Wörmlitz (Stange), Munich (Kranz), Rudolstadt (Meurer), Mecklen-burg (Schmidt), Bremen, rather rare (Rehberg), Saxon Upper Lusatia (Schütze), Dresden, common—near Loschwitz (Steinert), Prussia, not rare (Grentzenberg), Upper Lusatia, distributed, commoner in the lowlands (Moeschler), Ratisbon (Schmid), Dessau, pretty common (Richter), Wernigerode (Fischer), Pomerania, common — Dramburg, Stettin (Hering), Brunswick (Heinemann), Hanover (Glitz), Frankfort-on-Oder (Kretschmer), Ahrthal (Maassen), Eutin, rare (Dahl), Berlin district, sometimes common (Pfützner), Thuringia—Altenburg, Gotha, Erfurt, Nazza, Mülhausen, &c., rare (Knapp), Chemnitz (Pabst), Hildesheim, very rare (Grote), Heligoland (Gätke), Wiesbaden (Sich), Hesse-Nassau—Bieden-kopf (Jäger), Mecklenburg—Schwerin, rare (Voelschow), Holstein, Rendsburg, Cre-feld district, Elberfeld, Barmen, rare, Cassel, Leipzig, Drasisdorf, Fichtel-Gebirge, Kissingen, Augsburg, rare, Osterland, rare, Kempten, Nassau, Frankfort-on - Main, Trier, Oberhessen, Bavarian Palatinate (*teste* Bartel), Alsace—Zabern (Peyerimhoff), Baden—Constance, Carlsruhe, &c. (Reutti). GREECE: Acarnania (Staudinger). ITALY: north and central, frequent some years, rare others, also Sicily (Curò), Modena (Fiori), Roman Campagna, rare—Florence, Pisa, Lucca, Monte Rotondo, near Rome (Calberla), Lombardy, Pied-mont, Liguria (*teste* Bartel). NETHERLANDS: most provinces, not yet noted from Friesland (Snellen), Breda, not common (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: Grumazesti, Comanesti, Slanic, Tulcea in the Dobrudscha, Bucharest, &c. (Caradja). RUSSIA: Moscow Government (Albrecht), Crimea (Melioransky), Lower Volga district—Kasan, not rare, the lower Ural district —Orenburg, the upper Ural district, Sarepta (Eversmann), Transcaucasia—Tiflis, Börjom (Romanoff), St. Petersburg (Erschoff), South Russia (Moeschler), Baltic provinces—Livonia: Dorpat, Neu-Kasseritz, near Werro (Nolcken), Poland—Kamenez-Podolskii, Poltawa district—Lubny, south coast of Crimea—Alupka

(teste Bartel). SCANDINAVIA: Scania—Helsingland, and southern Norway (Zetterstedt), not rare, northern limit Helsingland (Aurivillius), Gudbrandsdal (Schöyen), Norway—Christiania, Vestre Aker, Odalen, Hedemarkia (Siebke), Hunneberg (Lampa). SPAIN: Galicia—Santiago (Macho-Velado). SWITZERLAND: almost everywhere, but in some places not common, goes up 5000-5500ft. (Frey), Weissenburg (Huguenin), Grisons (Killias), Bechburg (Riggenbach-Stehlin), Bern (Hiltbold), Lausanne (Chaumette), near Zürich (Dietrich), Upper Engadine (Pfaffenzeller), Aigle (Lowe), near Nyon, on Genfer See, common (Rätzer), Interlaken, near Thun, near Vevey, Aargau (Wullschlegel), Bremgarten, frequent (Boll), Schüpfen, not common (Rothenbach), St. Gallen, not common (Täschler), canton Glarus (Heer), Bergün (Zeller).

Tribe: HIPPOTIONIDI.

There is considerable doubt whether this should be considered a tribe apart from the *Eumorphidi*, or whether its constituent genera should not be considered as specialised items in the latter tribe. Pupally and imaginally, the Hippotionids *(celerio, osiris,* &c.) are much more specialised than the Eumorphids *(sens. strict.) (elpenor, porcellus,* &c.). On the other hand, the larvæ are very similar and appear to have specialised along the same lines, but our knowledge of the early larval stages of the Hippotionids is so entirely lacking, and the accuracy of some of that relating to the adult larvæ (see *antea*, p. 57) so open to doubt, that one feels on very unsafe and uncertain ground. We may, however, point out that Weismann, on larval characters, combines *(Studies in the Theory of Descent*, transl. p. 193) our Hippotionids and Eumorphids *(sens. rest.)* in his groups 2 and 3, which he diagnoses as:

The subdorsal line more or less retained, eyespots on the 1st and 2nd abdominal segments (these markings absent or at most only present in traces on the remaining segments)—*elpenor*, *porcellus*, *celerio*, *nessus*, *lucasi*, &c.

The subdorsal line retained in very variable degree; the eye-spots repeated on all the abdominal segments—*bisecta* (*silhetensis*), *oldenlandiae*, *alecto*, *acteus*, *tersa*.

Bacot, who has given considerable attention to the larvæ of this group, suggests (*in litt.*) to us the following grouping:

1. Adult larva with subdorsal lines; a single central mediodorsal ocellated spot on the 1st abdominal segment; subspiracular obliques with a tail to head slope; young larva with the pro- and mesothorax greatly lengthened—*Elibia dolichus.*

2*a*. Adult larva with ocellated spots on 1st abdominal only, very dorsal in position, no (or only exceedingly weak, and of different character) repetition of spots on 2nd abdominal—*Panacra vigil*, *nessus*, *lucasi*.

2*b*. Adult larva with a large and greatly developed ocellated spot on the 1st abdominal; a series of smaller spots of different shape and character on abdominal segments 2-7 on line of subdorsal band—*Pergesa acteus*, *Hathia clotho*.

3. Adult larva with ocellated spots on the 1st and 2nd abdominal segments in subdorsal line, not repeated on following segments—*Eumorpha elpenor*, *Theretra porcellus*.

4*a*. Adult larva with ocellated spots on the 1st and 2nd abdominals, more or less weakly repeated on the following segments—*Isoples alecto*, *Xylophanes oldenlandiae*, *Florina japonica*.

4*b*. Adult larva with ocellated spots on the 1st and 2nd abdominals, the character of the ocellated spots much nearer those of *Isoples* (*alecto*) than *Eumorpha* (*elpenor*, *porcellus*), the subdorsal line very strongly marked—*Hippotion celerio*.

Bacot has here advanced very considerably beyond Weismann's grouping and one is able to see in this arrangement the ground for at least two (possibly three) tribes on larval structure alone. Inverting 1, 2*a* and 2*b* we have undoubtedly three evolutionary steps in the development of a larva of which *Elibia* is the highest exponent known to us, and which might be termed *Elibiidi*. Again 4*a* and 4*b* appear to form two natural sections of our *Hippotionidi*. His group 3 still remains the exponent of our *Eumorphidi*

and the separation of this from the *Hippotionidi* must still be made rather on pupal and imaginal than on larval grounds. Bacot's general remarks on these groups are very pregnant. He says: "Groups 2*a* and 2*b* are thus marked because it is not at all clear whether the two do not form merely more generalised and more specialised branches of the same tribe, *lucasi* appears to be a primitive member of 2*a*. In group 4*a*, *Florina japonica* gives considerable trouble. Piepers figures the young larva with ocellated spots from the metathorax to the 8th abdominal which would, perhaps, throw it into a different group. In this group also *Isoples alecto* appears to be the nearest to *Eumorpha (elpenor)*, and the shape and character of its ocellated spots, although falling between those of *E. elpenor* and *Hippotion celerio*, approach more nearly to those of the former. In the latter, the ocellated spots are oval with the long axes vertical (all the figures examined agree in this); in *I. alecto* and *E. elpenor* the oval is not regular, flattened below, at least the central area, and the long axis is horizontal *; in *H. celerio*, again, a pale ring encloses a regular dark blue or purple oval with white specks on it; in *I. alecto* the dark blue centre has no white specks, and the dark (almost black) centre is irregular, curved at the top, flattened at bottom, illustrating how an *elpenor*-spot might enlarge into a *celerio*-like spot, not, of course, that I think that the spots of *celerio* are on the line of evolution of those of *elpenor*, but either might be evolved from a form near that of *alecto*. The larva of *H. celerio* appears to be near to those of *E. elpenor* and *T. porcellus*, possibly because it shows no repetition of the ocellated spot on the other abdominal segments, but the character of the spot differs far more from these than does that of *I. alecto*, and, further, the larva differs also from those of groups 4*a* and 3 by reason of the strong and well-marked subdorsal band †. The value of the groups marked is evidently unequal, *e.g.*, 3, 4*a* and 4*b* might probably, on larval characters, be thrown into a single tribe, although the resemblances may be due rather to convergence than really close relationship."

The pupal characters have already been dealt with (*anteà*, pp. 43, 59). The texture is delicate; colour pale terra-cotta with black patches and dots; wings with wrinkled sculpture; labrum dorsal, with keel round front sometimes produced into a horn arising anteriorly (and not ventrally as in *Sphinx*); anal spike various; portion of first femur exposed; special prespiracular sculpturing on 5, 6, 7 hardly present. Little or no flattening, last segment tapering. General sculpturing consists of transverse wrinkling, which has nearly overcome pitting, even on the last segment. It will be observed that it is mainly on the high specialisation of the pupa and imago that the tribe is founded. On these characters, the Phryxid tribe is nearer to the Hippotionid

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* The odd shape of the ocellated spots in *Eumorpha elpenor* and *Theretra porcellus* shows a very long evolution, and one suspects a special one. This irregular form does not appear to occur in the Hippotionids and it follows that Hippotionids could not be derived from *Eumorpha* (Chapman).

† The figures examined differ considerably in general appearance, chiefly on account of the prominence (or want of it) given to the subdorsal bands and to certain features of the ocellated spots (compare the figures of Buckler, Hofmann, Kirby, &c.). Some of the figures give the larva a much more *elpenor*-like facies than others (Bacot).

than is the Eumorphid, although in the larval stage the two last-named have varied much in the same way.

On imaginal characters, Kaye gets the following subdivisions:

1. Head closely set on thorax, pointed, eyes large; forewings with broad oblique straight pale stripe from apex to inner margin; hindlegs very long—*oldenlandiae*, *pinastrina*, *japonica*, *intersecta*, *celaeno*, *schenkii*.

2. Head broad, eyes very large; forewings with an oblique pale semi-metallic bent stripe from apex to inner margin; hindlegs long (but scarcely so long as in 1); abdomen with lateral pairs of semi-metallic spots—*celerio*, *osiris*, *vigil* (*lignaria*).

3. Head and thorax projecting well before costal line of forewing; forewings brown with several oblique lines from apex to inner margin; hindwings with a dark marginal band; abdomen long and tapering—*alecto* *, *eson*, *trilineata*, *thyelia*, *licaor*.

Kaye further notes that "the Hippotionids shade off into the *Eumorphidi* through *schenkii*, *charis*, *oldenlandiae* and *japonica*, the latter approaching, though yet a long way from, *elpenor*.

Genus: HIPPOTION, Hübner.

SYNONYMY.—Genus: *Hippotion*, Hb., "Verz.," p. 135 (*circ.* 1822); Stphs., "Ill. Haust.," iv., app. p. 5 (1835); "List Br. An. Br. Mus.," p. 28 (1850); Moore, "Lep. Ceylon," ii., p. 16, pl. lxxxiv., fig. 4 (1882); Kirby, "Handbook," &c., iv., p. 20 (1897); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 491 (1758); xiith ed., p. 800 (1767); Hfn., "Berl. Mag.," ii., p. 182 (1766); Fab., "Sys. Ent.," p. 545 (1775); "Spec. Ins.," ii., p. 151 (1781); "Mant.," ii., p. 9 (1787); "Ent. Syst.," iii., pt. 1, p. 370 (1793); Cram., "Pap. Exot.," ii., pl. 125, fig. E (1777); [Schiff.,] "Schmett. Wien.," p. 42 (1775); Ill's. n. Ausg., p. 16 (1801); Esp., "Schmett. Eur.," ii., pt. 1, p. 83, pl. viii., figs. 1—3 (1779); pl. xxii., fig. 1 (1780); p. 176, pl. xxviii., fig. 1 (1782); ii., pt. 2, p. 34, pl. xlv., fig. 3 (? 1800); Bergstr., "Sphing. Larv.," p. 10 (1782); Bork., "Sys. Besch.," ii., pp. 70, 138, 178 (1789); [F.J.A.D.,] "Rhein. Mag.," p. 315 (1793); Hb., "Eur. Schmett.," ii., figs. 59, 146 (1796); text p. 96 (*circ.* 1805); "Larv. Lep.," ii., Sph. iii., Legit. B. a. b. figs. 1 *a-b* (*circ.* 1800); Don., "Brit. Ins.," vi., p. 25, pl. cxc (1797); Haw., "Lep. Brit.," i., p. 61 (1803); Latr., "Hist. Nat.," xiv., p. 132 (1805); Ochs., "Die Schmett.," ii., p. 205 (1808); Shaw and Nodder, "Viv. Nat.," xx., pl. 860 (1809); Lam., "Mém. An. sans Vert.," i., p. 32, pl. ii., fig. 1 (1816); Godt., "Hist., Nat.," iii., p. 43, pl. xviii., fig. 2 (1821); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); Meig., "Eur. Schmett.," ii., p. 134 (1830); H.-Sch., "Sys. Bearb.," ii., p. 86 (1846); Speyer, "Geog. Verb.," i., p. 316 (1858); Hein., "Schmett. Deutsch.," i., p. 145 (1859). *Spectrum*, Scop., "Introd. Hist. Nat.," p. 413 (1777). *Deilephila*, [Lasp.,] "Jena. Allg. Lit. Zeit.," iv., p. 109 (1809); Ochs., "Die Schmett.," iv., pp. 42, 43 (1816); Stphs., "Ill. Haust.," p. 128 (1828); "Cat. Br. Ins.," ii., p. 33 (1829); Wood, "Ind. Ent.," p. 17 (1839); Bdv., "Icon. Chen.," pl. 13 (*circ.* 1840); "Gen. et Ind. Meth.," p. 47 (1840); Dup., "Cat. Méth.," p. 42 (1844); Heyd., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Staud., "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 37 (1871); Montr., "Ann. Soc. Lin. Lyon," (2,) xi., p. 250 (1864); Ramb., "Cat. Lép. And.," p. 131 (1866); Snell., "De Vlind.," p. 94 (1867); Berce, "Faun. Franç.," ii., p. 23 (1868); Nolck., "Lep. Fn. Estl." i., p. 88 (1868); Mill., "Cat. Lép. Alp.-Mar.," p. 118 (1872); "Nat. Sic.," vi., p. 4, pl. i., figs. 8-9 (1886); Cuní y Mart., "Cat. Lep. Barc.," p. 40 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 111 (1875); Frey, "Lep. Schweiz," p. 58 (1880); Auriv., "Nord. Fjär.," p. 46 (1889); Minà-Pal., "Nat. Sic.," vii., p. 134 (1888); Meyr., "Handbook," &c., p. 296 (1896); Bartel, "Pal. Gross-Schmett.," ii., p. 104 (1900). *Elpenor*, Oken, "Lehrb. Zool.," i., p. 760 (1815). *Eumorpha*, Hb., "Franck Cat.," p. 87 (1825). *Choerocampa*, Dup., "Hist. Nat.," supp. ii., p. 159 (1835); Humph. and Westd., "Brit. Moths," i., p. 21 (1841); Dbldy., "List Brit. Lep.," p. 3 (1847); Sta., "Man.," i., p. 96 (1857); Humph., "Gen. Brit. Moths," p. 11 (1860); Newm., "Brit. Moths," p. 9 (1869); Bdv., "Hist. Nat. Sphing.," p. 238 (1875); Kirby, "Eur. Butts. and Moths," p. 71, pl. xvi., fig. 2 (1879); Auriv.,

* *Alecto* has broader wings than the other species included in this group, but otherwise agrees very well with it (Kaye).

"Sv. Vet. Hand.," xix., p. 140 (1882); Buckl., "Larvæ," &c., ii., p. 113, pl. xxv., fig. 2 (1887); White, "Butts. and Moths of Teneriffe," p. 69, pl. iv., fig. 2 (1894); Barrt., "Lep. Brit.," ii., p. 51, pl. li (1895). *Metopsilus*, Dunc., "Brit. Moths," p. 159 (1836). *Chaerocampa*, Walker, "List," &c.," viii., p. 128 (1856); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 557 (1876); Hampson, "Ind. Moths," i., p. 87 (1892); Staud., "Cat.," ed. 3, p. 103 (1901). *Theretra*, Kirby, "Cat.," p. 652 (1892).

The genus was founded (*Verz.*, p. 135) by Hübner, about 1822, when he gave the following diagnosis:

> The forewings externally with oblique white bands and brown stripes, also white nervured; hindwings with almost red spots—*Hippotion celerio*, Linn., *H. ocys*, Hb. (*celerio*, Cram.).

Kirby gives (*Cat.*, p. 653) *ocys*, Hb. = *celerio*, Linn., which makes *Hippotion* monotypical. This diagnosis, like all those of the *Verzeichniss*, is very poor. The principal characters appear to be:

> IMAGO: Head broad, eyes very large; forewings with an oblique, pale, semi-metallic curved stripe from apex to inner margin; hindlegs long; abdomen with lateral pairs of semi-metallic spots. PUPA: Labrum dorsal; texture delicate; black spots round spiracle, and dots down wingcases; anal spines sharp, delicate, polished, with two comparatively long divergent apical points. LARVA: Subdorsal line retained from 3rd to 8th abdominal segment; ocellated spots on sides of 1st and 2nd abdominals.

Moore diagnoses (*Lepidoptera Ceylon*, ii., p. 16) the genus as follows:

> Forewing long, narrow, slightly arched towards end, apex acute, exterior margin very oblique, slightly convex in the middle, posterior margin much recurved; first subcostal emitted at two-fifths and second at one-fifth before end of the cell, fifth immediately beyond end of cell; discocellular inwardly oblique, slightly bent beyond the middle, radial from the angle; middle median at one-sixth, and lower at two-thirds before end of the cell; submedian much recurved from the base; with a lower branch one-fourth from the base; hindwing narrow, apex pointed, anal angle prominent; subcostal spur short; two subcostal branches from end of the cell; discocellular slightly recurved, outwardly oblique, radial from the middle; cell extending more than half the wing; middle median at one-sixth, and lower at one-third before end of the cell. Body stout, thorax broad; palpi pointed in front; antennæ short, pectinate; legs long—*Hippotion celerio*.

There are, according to Kaye, only two species belonging to this genus—*celerio* and *osiris*. *Panacra vigil* he also considers somewhat close. Kirby notes the genus as resembling *Eumorpha*, but with the wings longer, narrower, and more pointed, and the legs and body longer and more slender; the body and wings adorned with silvery stripes; the hind margin of the forewings more oblique and sinuated, the anal angle projecting downwards almost in a tooth; the anal angle of the hindwing sub-lobate. Of the two species included in the genus—*celerio* is distributed throughout almost the whole of the tropical and subtropical districts of the Old World, migrating into the warmer temperate regions, whilst *osiris* occurs in western Africa and southwest Europe. The allied *Panacra vigil* is found in India, Ceylon, the Philippines, and Queensland, occurring in Australia in the same districts as *H. celerio*.

Marshall's remarks (*Trans. Ent. Soc. London*, 1902, pp. 397-398) and experiments on the value of the terrifying marks in the larva of *Hippotion osiris* are most interesting. He observes that the full-grown larva is about 7ins. long, remarkably snake-like, the general colour somewhat recalling that of the common puff adder (*Bitis arietans*). Offering one to some baboons, he found that they were exceed-

ingly afraid of it. He writes: "Their terror of the insect was most amusing, and was an eloquent testimony to the great value of this form of colouring to so bulky a larva. I do not think that anyone could now argue that the theory of terrifying coloration is farfetched, as I have heard contended. The snake-like appearance seems capable of deceiving more intelligent animals than baboons," &c.

HIPPOTION CELERIO, Linné.

SYNONYMY.—Species: *Celerio*, Linn., "Sys. Nat.," xth ed., p. 491 (1758); xiith ed., p. 800 (1767), &c. [NOTE.—All references in the generic synonymy (*anteà*, pp. 116-117) are referable to the specific name *celerio*, except the following: *Tisiphone*, Linn., "Sys. Nat.," xth ed., p. 492 (1758); xiith ed., p. 803 (1767); "Mus. Ludov. Ulric.," p. 359 (1764). *Ocys*, Hb., "Verz.," p. 135 (*circ.* 1822). *Albolineata*, Montr., "Ann. Soc. Linn. Lyon," (2,) xi., p. 250 (1864).]

ORIGINAL DESCRIPTION.—*Sphinx celerio*, alis integris griseis lineola albo nigra; inferioribus basi rubris maculis sex. Goed., *Ins.*, 3, f. γ. Frisch, *Ins.*, 13, t. 1, f. 2. List., *Goed.*, f. 26. Roes., *Ins.*, 4, t. 8. Habitat in Vite (Linné, *Sys. Nat.*, xth ed., p. 491).

IMAGO.—78mm. Anterior wings brown; a wide curved silvery-white or ochreous fascia from the apex to the inner margin near the base, edged internally with blackish, and with two slender darker lines running almost medially throughout its length; a number of short longitudinal darker and paler dashes between the fascia and costa; a faint silvery wedge at base medially; the pale raised nervures pass distinctly through the fascia, and are superiorly edged finely with blackish; a minute black discoidal spot; a fine subterminal silvery line, edged with darker towards the anal angle; the inner marginal edge also silvery; cilia brownish. Posterior wings rosy, paler (pink) towards the outer margin; dusted with black scales towards apex; a median black band from costa not reaching inner margin; a fine black submarginal band; nervures black, joining the median and submarginal bands; cilia white, suffused towards apex.

SEXUAL DIMORPHISM.—The ♂s appear to be rather larger than the ♀s, and to be longer in the body; a ♀ without eggs is, however, very similar in outline, if a little shorter. The ♂ has the larger head, measuring about 1·0mm. more across the eye at widest part, than the ♀. The ♂ antenna is about 12·5mm. long, that of the ♀ 10·5mm. Owing to the ♂ antennæ being armed with the Sphingid hair cups, it looks larger than that of the ♀ to an extent greater than it really is. In both sexes the number of joints appears to be about the same, *viz.*, about 63. Each has three rows of scales to a joint, of which the third is very short and hardly seen. The ♂s have a well developed fan of (scent?) hairs in a pocket at each side of the basal abdominal segment. The anterior tibial spurs are larger in the ♂ than in the ♀. This corresponds in some degree to the fact that the tibia itself is shorter in the ♀ than in the ♂. The smallest male tibia measured was over 4mm. long; no ♀ quite reached this, whilst in the ♀ they varied down to 3·4mm. The spurs of two specimens measured (taken at random, but possibly a little exaggerating the difference) were ♂ 2·2mm., ♀ 1·82mm. There is a still greater difference in the size and length of the comb, which occupies two-thirds of the length of the ♂ spur, and is 0·28mm. wide, is barely

two-fifths of the length of the spur in the ♀, and is only 0·2mm. in width. This comb is very beautiful in many of these Sphinges, in *H. celerio* it reminds one greatly of the row of teeth or keys in a musical box. The palpi seem to be identical in the two sexes (Chapman).

VARIATION.—The species is distributed over almost the whole of the Old World. The Teneriffe examples are somewhat smaller than those from southern Europe, but identical in coloration (Christ). Kaye writes *(in litt.)*: The variation appears to be sporadic, not geographical; the band varies in being more curved in some examples than in others, and, also, in being sometimes darker and at others lighter, but these variations do not seem to be restricted to local forms; occasionally, also, the pink of the hindwing encroaches on the black patch towards the centre of the wing; in my South African examples, the short silvery streaks, particularly on the inner edge of cell and on nervures 6 and 7, are much reduced or almost absent. Mathew observes *(in litt.)* that specimens from the west coast of Africa, from Britain, Madeira, and the Pacific Islands, show very little difference. Bartel states that examples from tropical countries are larger and sometimes reach a wing-expanse of 82mm., and are strikingly different from the European examples, both in colour and markings. Walker notes the examples reared in Tahiti, as having the oblique stripe on the forewings much more silvery than in any examples observed in British collections. This Pacific form, which appears to be the Linnean type, was redescribed by Montrouzier from Kanola, New Caledonia, in the *Ann. Soc. Linn. Lyon*, n.s., xi., p. 250 (1864) as:

Deilephila albolineata. Kanola. Envergure de 5cm. 8mm. à 7cm. Les ailes supérieures sont en-dessus d'un brun légèrement olivâtre, avec la majeure partie de leurs nervures, et chacune 3 bandes, d'un blanc soyeux brillant, la 1re bande est la plus large et elle est un peu coudée et placée après la moitié de la largeur de l'aile; les autres sont plus étroites, d'un blanc moins pur et moins brillant, placées à la suite l'une de l'autre près du bord postérieur; la 2me est la plus mince. Les ailes inférieures sont d'un brun clair et rougeâtre, avec une tache rose à la base, avec le bord postérieur et une bande avant celui-ci d'un rose pâle, cette bande est composée de petites taches oblongues placées à la suite l'une de l'autre. En-dessous les ailes sont roussâtres, avec leur base brunâtre, et leur bord postérieur grisâtre. *Corps* ayant la tête et le corselet d'un brun légèrement olivâtre, et le reste rougeâtre. On voit de chaque côté une bande d'un blanc soyeux partant du bord antérieur de la tête et s'étendant sur le corselet jusqu'à la naissance des ailes; en-dedans de cette bande et de chaque côté existe sur le corselet une petite ligne longitudinale dorée, enfin sur le milieu du corselet une bande blanche qui se continue jusqu'à l'extrémité de l'abdomen. Chacun des anneaux de celui-ci est marqué postérieurement, de chaque côté de la bande blanche, de deux petites taches linéaires de la même couleur.

Oberthür writes *(in litt.)* that there is some slight variation in the species; the band which crosses the upper wings is sometimes more or less silvery, at others brown like the ground-colour of the wings *(e.g.*, an example from Madagascar); the spots on the abdomen also are more or less dark, and more or less strongly marked. The rosy tint of the hindwings varies also in intensity. The chief variation seen is in the ground-colour being pale terracotta (ab. *pallida*, n. ab.) or a deep rich brown (ab. *brunnea*, n. ab.). Linné's type is that which has the whitest band; that form in which the band is only somewhat paler than the ground-colour appears to be Linné's var. *tisiphone*, described as:

Sphinx tisiphone.—Sphinx alis primoribus cinerascentibus vitta pallida;

postice supra nigris basi rubris. *M. L. U.* Habitat in India. Magnitudo Asili; alæ inferiores lineis 6 obliquis parallelis carneis.

The form in which the oblique band is unicolorous with the rest of the wing-area, and only marked out by the transverse lines, we would call ab. *unicolor*, n. ab. The only aberration that seems to have been described is the following:

a. ab. *augustii*, Trim., "Actes Soc. Linn. Bord.," xxii., p. 24 (1859).—Entirely black, same markings as type. Captured in 1855 by M. Auguste of Bordeaux.

Comparison of H. osiris and H. celerio.—*H. osiris* comes very near *H. celerio*, but the markings of the forewings are less silvery, the marginal band of the hindwings is twice as broad, the black basal markings are less distinct, the nervures on hindwings not lined with black; the body similar, but the principal stripes are pinkish, and there are two interrupted black bands on the first segments of the abdomen. Universally diffused in Africa; once reported from Cadiz (Kirby, *E.M.M.*, i., p. 211). *H. osiris* is larger than *H. celerio*, from ·125in.—·2in., in both sexes. The head and eyes also are more prominent. The wings are more ample; there is usually a pink suffusion over the whole of forewing; the band is considerably straighter, and there is a strong indication of a second parallel oblique band midway between costa and first band. In the hindwings the black scaling on the nervures of *H. celerio* is absent, so that the pink is more prominent. The abdomen is stouter, is at once distinguished by having only a single subdorsal row of elongated silvery spots, the line effect much more pronounced than in *H. celerio* (Kaye).

Egglaying.—The eggs are green in colour at first, laid singly on the upper or lower side of the leaves of the foodplant, the oval period, at Tangier, lasting about 9 days (Meade-Waldo). In Queensland, oviposition continues through the winter — May to July — although the shade temperature rarely falls below 70°F. (Dodd).

Ovum. — Pyriform, of a light pea-green colour, becoming clayey-yellow just before the emergence of the larva. Duration of egg stage 15 days. The eggs were laid at the end of September, 1885 (Millière). The egg is rather citron-shaped than pear-shaped, smooth, pale green, becoming yellow before the larva emerges (Bartel).

Habits of larva.—Swinton records "the young, black, horned larvæ as being found at Jerusalem in the cobwebby corners of the vineyards where the vine leaves were drilled by the larvæ of *Ino ampelophaga;* they then developed the peacock eyes, became pupæ and produced imagines in the autumn." Bell notes that, "in the autumn of 1885, a virginia-creeper on his house in the Bilbao district of northern Spain swarmed with the larvæ; they were of all sizes from half an inch to fullgrown, and six dozen were collected and fed, the smallest not pupating until well into November, although the earliest pupa produced an imago without artificial heat in September; the other pupæ were exposed to a day temperature of about 75° F. and a night temperature of about 60° F., with the result that the imagines all emerged the same year, the last on Christmas day." A larva was obtained at Firle, near Lewes, on September 23rd, 1885, as large as a fullfed larva of *Sphinx ligustri*,

the cat-like appearance of the head, when at rest, being very formidable; this larva spun up on October 4th, but did not pupate until November 4th, and died without producing an imago (Edgell). A very delicate-looking green larva, found not rarely on the Taro, the Nono, and especially on the Apé in Tahiti, produced imagines of this species (Walker). In the British Isles, larvæ are usually only found in the autumnal months, October and November, evidently the progeny of immigrants of August-September, and this seems to be the only brood normally found in southern Europe. Larvæ were very abundant in France in September, 1846 (imagines had appeared in August). Four larvæ were found on vine, October, 1865, at Newmarket (Postans), one of these was sent to, and figured by, Buckler on November 8th, 1865 (*Larvae*, &c., pl. xxv., fig. 2), fullfed larva October 7th, 1865, at Epping (Doubleday), larva at Dublin, November, 1877, on vine (Kirby), larva nearly fullfed on October 4th, 1878, in a garden at Brighton (Brazenor), on September 23rd, 1885, at Firle (Edgell), and in October, 1885, at Tenbury (Decie), larvæ are also recorded from near Wisbech (Skrimshire *teste* Haworth), Ely (Jenyns *teste* Stephens), Norwich (*teste* Stephens), Southsea (Moncreaff *teste* Pearce). In subtropical countries the larvæ are to be obtained in May-June, August and October-November, and the insect is double-, triple-, or even continuously-brooded according to climatic conditions. A single larva was taken on September 9th, 1896, at Sofia (Bachmetjew). Swinton obtained larvæ at Jerusalem in May and June, 1896; in Queensland (winter) (Dodd), the larvæ again from September-November (spring) the larva occurs in May-June (autumn), the moths in July-August feeding up before the end of the month (Ash). At Beyrout, Lederer records that the larvæ are to be found in May and August.

LARVA*.—*After the second moult* the larva has the 11th segment surmounted by a very long horn. The larva itself is relatively short, cylindrical, of a pale green, washed with yellow below, the true legs and prolegs well developed. The caudal horn is lowered and raised at the approach of danger, forming, to all appearance, a means of defence for the young larva; it is falcate, thick at base, very pointed at the tip, and of an uniform clear maroon colour throughout its length (Millière, *Nat. Sic.*, vi., p. 4, pl. i., figs. 8-9). Sepp figures and describes (*Ned. Ins.*, viii., pl. l., figs. 2, 3, 4, no. 50), the larva as follows: Received on September 11th a very young larva found on vine, very similar to that of *E. elpenor* (which I had already reared from the egg) and a close examination led me to doubt whether I had not made a mistake in the species; it moulted before I had figured it. *Second instar* (?): 18mm. long, of a lively bright green in colour, the first five segments yellowish, the head of a light purple; on either side of the 4th and 5th segments are two dark marks; the very long horn on the 11th segment dirty

* Swinton notes the young larva as "black and horned, developing later its peacock eyes." The following note by Meade-Waldo (*Ent.*, xxxv., p. 196) appears to be an off-hand impression rather than the result of special observation: "The larva when first hatched is light green in colour, with a long pink horn; when about a week old it has purple eye-like marks on the enlarged segments behind the head." We very much doubt the development of the eye-spots so early. See Sepp's description (*suprà*), from which one gathers that they do not appear until the 3rd instar.

green. *Third instar* (?) (Moulted on 22nd): Of a lively green colour; the first eye-spot yellow, with a black border below, the second one smaller, white with a black border; the head green; the caudal horn purple, green beneath at its base; under a lens the larva is seen to be stippled with fine white points. *Fourth instar* (?) (Moulted on 30th): Retained the same coloration; the head green with two V-shaped stripes of a light brown colour; the eye-spot of the 4th segment somewhat oval, with green stippled centre, surrounded by two rings, the outer one dark bluish-green, the inner light yellow; the second eye-spot yellow, surrounded by bluish-green. The lateral (subdorsal) stripes bluish, but dark greenish above, with the lower half white; the oblique lateral stripes faint whitish; the caudal horn shorter, purple in colour, the stigmata white. The next moult was not observed, but the fullgrown larva was as figured in vol. vii. The *fullgrown larva* of this species is figured by Buckler (*Larvae, &c.*, ii., pl. xxv., fig. 2). The drawing was made on November 8th, 1865, from a larva found at Newmarket and fed on vine leaves. It is of a dark sepia-brown colour, with a pale greyish-yellow subdorsal line continued from the prothorax to the base of the caudal horn, broad from the prothorax to 2nd abdominal, narrower to the base of horn, and then turning down at the base of the horn to the anal segment as a wide yellowish patch. The spiracles small and white, ringed with black, with a small red supraspiracular spot above each on the 2nd, 3rd, 4th, 5th, 6th, 7th and 8th abdominal segments. The head is of the same brown hue as the body. The three thoracic segments are striped longitudinally with two broad, pale, greyish-brown stripes (1) subdorsal (2) just above the legs. There is a large ocellated spot with a large black centre and pale ochreous margin placed above the spiracle on the 1st abdominal segment, and a second smaller unicolorous pale ochreous spot, with a black margin above the red supraspiracular dot of the 2nd abdominal segment. These two ocellated spots are in the subdorsal line. The abdominal segments are divided into 8 subsegments. The caudal horn is moderately short but straight, almost erect and pointed. The terminal segments slope very rapidly from the base of the caudal horn to the anal extremity. Bartel describes (*Pal. Gross-Schmett.*, ii., p. 105) the fullgrown larva as "measuring 80mm.-90mm.; very variable, occurring in both brown and green forms, usually, however, glossy blackish-brown; on each side of segments 4 and 5 stand two circular black ocellated spots, margined with yellowish-white or dark green, and with white centre. Instead of the white pupil, which is placed somewhat sideways, there may occur from three to seven whitish-yellow dots in the middle. The small eye-spot behind the first spot may be either distinct or wanting. It is sometimes also replaced by an unicolorous yellow spot, somewhat lighter margined. Above the legs runs a lighter, often yellowish, longitudinal, lateral stripe, interrupted at the segmental incisions, at the upper margin of which stand the yellowish or yellowish-white spiracles, which are enclosed by black. Somewhat lower than the two eye-spots appears, extending from segments 6-11, a light brown or whitish-yellow stripe, which is continued on the straight and erect horn. The dorsum is covered with fine black longitudinal streaks. On the venter fine white dots are interspersed

in the ground-colour. The first three segments are prolonged anteriorly into a snout; they are retractile within the 4th segment. The horn on segment 11 is long and thin, red-brown with only the tip black. The small head, the collar and the legs are likewise red-brown, the prolegs lighter brown." The *fullgrown larva* is dirty-brown, thickly covered with short black lines; the 2nd, 3rd and 4th segments immaculate; there is a large ocellus on the 5th segment, and a smaller one on the 6th; from this segment a pale lateral stripe runs into the caudal horn; the under parts, below the spiracles, not freckled with black. [The larva, taken at Epping, was too near its pupation for a good description to be made.] (Doubleday, *Ent.*, ii., p. 327). Moore notes (*Lep. Ceylon*, ii., pl. lxxxiv., fig. 4, p. 16): "Larva green or purplish-brown; on 5th and 6th segments are two* round black ocellated spots dotted with yellow, and encircled by a yellow ring, that on the 5th segment the larger; horn brown, slender and straight." The larva is brown; above the legs runs a yellow stripe in which stand the black-margined spiracles. Above this, begins on the 6th segment, a second, which terminates in the straight blunt anal point. On the 4th and 5th segments stand on either side two circular black yellow-margined eye-spots, having a white spot somewhat to the side (Ochsenheimer, *Die Schmett.*, ii., p. 205).

Variation of larva.—There are brown and green forms of the larva as in *Eumorpha elpenor* (Meade-Waldo). Four larvæ taken at Newmarket on vine in October, 1865; one was purplish-brown with a brown caudal horn, the other three green with brown caudal horn. Each had two spots on the 5th and 6th segments that near the head much larger than the other; these spots bright silvery, but, as the larvæ approached the pupating stage and became very dark, the spots became quite black with a yellow rim round them (Postans, *E.M.M.*, ii., p. 162); two of these larvæ were described on November 9th as differing in colour, one being light brown and one green, having an eyelet with a silvery pupil on the 4th and 5th segments, and a pale line extending from them to the horn (Gaze, *Ent.*, iii., p. 6). One of these four larvæ is that figured by Buckler (*Larvae*, &c., pl. xxv., fig. 2). The larvæ are common in November at Southport, in Queensland, feeding up before the end of the month; a green form of the larva is found commonly; Buckler figures only the brown one, which, however, is accurately

* Hübner's figure has ocellated spots on the 4th and 5th segments, and a broad yellow line extending from the horn to the 6th segment, whilst it is completely absent on the three front segments (*Studies in Theory of Descent*, p. 193). In Buckler's figure (*Larvae*, &c., pl. xxv., fig. 2) the ocellated spots are also on the 4th and 5th (*i.e.*, the 1st and 2nd abdominal) segments, but the subdorsal line is wider on the thoracic and 1st and 2nd abdominal segments, and narrower on the abdominals 3 to 8. In *C. celerio*, from India, as figured by Horsfield and Moore (*Cat. Lep. Ins. East Ind. Comp.*, pl. xi), the subdorsal line appears to have completely vanished, whilst eye-spots are present on all the segments from the 4th to the 10th, their size diminishing from the head to the tail. The European form of the same species has eye-spots only on segments 4 and 5, and Moore's later description, here quoted, of the Cingalese larva of the species, agrees with the European. One suspects, therefore, that that figured by Horsfield and Moore may not belong to this species (refer, *Studies in Theory of Descent*, pp. 196-7). Ash notes that Buckler's figure accurately portrays one form of the larva as found in Queensland.

portrayed (Ash). Snellen notes that he once found the larva at Rotterdam on vine, at the end of September, and adds that Rösel's figure is altogether excellent; the horn is not pointed but thin and blunt.

Cocoon.—Bartel observes (*Pal. Gross-Schmett.*, ii., p. 105) that the larva changes from 3cm.—4cm. below the ground into a red-brown or brown-grey pupa. Doubleday notes (*Ent.*, ii., p. 327) that a larva he had spun a few lumps of earth together in a corner of the breeding-cage. Postans observed (*E.M.M.*, ii., p. 162) that the larvæ in his possession pupated under leaves on the surface of the ground. Edgell records that the larva exudes a brown fluid from the mouth when making its puparium. Oberthür notes that for pupation the larva spins together with silk several leaves on the surface of the ground. Dodd states that the larvæ spin a silken web, and that, at Townsville, in Queensland, in June and July (the Australian winter), the pupal stage lasts only about three weeks. In Syria, Lederer says that the pupal stage lasts only 14 days.

Pupa.—The colour (like that of the pupæ of most Chœrocampids) is a pale terra-cotta, and very closely resembles that of *Daphnis nerii* (probably owing to the general tone of colour and marking); the black spiracular marks are proportionally smaller, but the disseminated black markings are more pronounced, especially ventrally and on the wing-cases, where they are wanting in the pupa of *D. nerii*. The ground-colour is very much paler than in the pupa of *Hyles euphorbiae*, but the dark markings bring them a little nearer in general tone. The general form is much that of *H. euphorbiae* or *Celerio gallii*; each individual segment is, however, of more uniform cylindrical or conical form, less rounded and bulging. This somewhat obscures the incisions and gives a rather smoother tapering outline. In the ♀ pupa the tapering is hardly marked at the 6th abdominal segment, in the ♂ pupa it begins with the 4th. As compared with the pupa of *H. euphorbiae*, there is a stronger point of difference in the labrum being not anterior but almost dorsal, the very pronounced keel of the proboscis arching right forwards and over the anterior extremity of the pupa. [In this respect it agrees with the pupa of *Isoples alecto*; in that of *D. nerii* the labrum is not quite so dorsal.] The front of the pupa thus comes to consist of the keel of the maxilla-cases, with a median impressed line or suture, and sides rugose at the carina, but smooth beyond it. The length is about 44mm., *i.e.*, 5mm. from front to base of 1st leg, 24mm. to end of maxilla, and 15mm. to end of anal spine; width 9mm.-11mm. The ♂, rather tapering in the abdominal segments from the 4th, looks much more slender than the ♀, which tapers from the 6th, at least in most typical specimens. The projection of the maxillary keel ventrally is marked as well as anteriorly. The antennæ and first legs reach to 18mm. from the front; the second legs 3mm. further; maxillæ to end of the wings; about 12mm. from the front to the small piece of 1st femur (that is usually present in Sphingid, but not Amorphid, pupæ). A condition that exists in the pupa of *H. euphorbiae*, and is very easily seen in that of *D. nerii*, is, in this species and *I. alecto*, so marked as to force itself on one's attention, *i.e.*, the greater length of the 4th abdominal segment

anteriorly than posteriorly, as if the wings and proboscis, in their demand for greater length, had stretched it downward. The general straightness of the pupa is preserved by a reverse state of the 5th abdominal, which is longer dorsally, but with a resulting slight S bend in the pupal axis. The other features of the pupa come rather under the head of surface-sculpturing and -marking. The sculpturing is not deeply impressed, and gives to the casual view the idea of a smooth pupa; the general character is that of transverse wrinklings, nowhere having any approach to points, spicules, or flanges of any sort, nor do the spaces between the wrinkles anywhere incline to be pits. The labrum is quite dorsal, rather square, faintly divided into two portions. The headpiece has faint sutures running up from angles of labrum, with glazed eye at its posterior angles. The prothorax has a nearly transverse hindmargin, the front is hollowed against the headpiece, slopes off to a sharp angle against the spiracle, which has a thickened margin on the prothorax and a still thicker one against the mesothorax; no spiculation. There is a somewhat smooth centre on each side of the prothorax, from which wrinkles radiate; the anterior margin has rather stronger wrinkles, making it look thick and raised. The antenna-cases have fine transverse lines corresponding with the segmentation, apparently two ridges to a segment; towards the end of the antenna the segments seem marked by a fine line, and the ridges are formed of rows of minute tubercles, with longitudinal dividing lines, marking off shaft and pectinations (which the imago is without); more basally, a central row of tubercles (one to a segment) consists of very definite, though small, raised points. The colouring of the appendages is, like the rest of the pupa, terra-cotta with black spots, the latter variable, absent on the antennæ, and distally on the legs and proboscis; basally they may be numerous or few, large or small; they tend to aggregate into patches on the leg-bases and adjacent portions of proboscis. The mesothorax has wrinkles consisting of very small raised surfaces arranged transversely in ridges, much broken up into islets, but not destroying the generally transverse alignment. The quasi-suture, marking the wing-base, is just discernible as a smoother band extending from middle of lateral half of front line, to anterior projection of metathorax. Outside this are various smooth patches, ill-defined, one of which, with a central elevation or two, seems to be the wing-spine area, discoverable in many Sphingid pupæ, but here, at first sight, quite absent. The wings are extraordinarily well-marked. The nervures are raised ridges along each of which is a row of black spots, more marked costally and towards hindmargin than basally; Poulton's line at apex may have a dark line. The area of wing between the nervures has very numerous fine longitudinal wrinkles, looking like a rough woollen or silken surface well brushed down. Poulton's line is very distinctly marked at the costal apex and along the greater part of the hindmargin, there are no black spots beyond it, and the "brushed down" wrinkles run across it with a definite break. The eight nervures that reach the hind margin in the imago are all extremely distinct, as well as 1*c*, which is, however, without black spots, the three more costal nervures cannot be individualised. The metathorax is narrowed medially; the surface is very smooth

and shining, the valleys between the wrinkles being wide and shallow. The hindwings extend to the end of the 2nd abdominal segment, slightly encroaching on the spiracle of that segment, yet with a deep sinuation here as if the spiracle held it back, or as if it desired to minimise its encroachment; beyond the spiracle the narrow slip has a median (Poulton's) line. The abdominal segments dorsally present sometimes merely the ordinary wrinkles, and are otherwise very smooth and level; in other specimens certain deeper impressions on the anterior segments indicate subsegmentation, but rather indefinitely, nor can the intersegmental subsegment be made out; on a well marked dark specimen subsegmentation is apparent on segments 5 and 6, usually these are quite smooth (apart from the fine wrinkling); in this one also, a dorsal depression (as in some Amorphids) can be traced, and is most marked at anterior margins of abdominal segments 5, 6 and 7. The wrinkled waves are small at the front of segment, and a little irregular (as by cross-waving breaking them up into short portions); posteriorly and laterally they run in definite transverse waved lines; in front of the spiracles their crests are rather sharp, but there is no other trace of the special development shown here in some Sphingid pupæ; the cicatrix of horn is a small, shallow polished hollow. Ventrally the cicatrices of prolegs on abdominal segments 5 and 6 are slight, shallow depressions practically evanescent; there is a pitted spot outside this (the triple ventral tubercle?); sometimes there is a slight smoothness, or silky polish on the cicatrix, at other times it is practically absent. There is a central ventral furrow along abdominal segments 5, 6 and 7, marked by a black line; the line is more persistent than the groove, which may be wanting. The anal armature is a spine rather longer than broad at its base, ending in a more slender portion, which is smooth and polished and armed with two sharp points, one diverging to either side at its extremity; length of spike 2mm., width at base 1·3mm., thickness at base 1mm. The colouring of the abdominal segments is very variable; the golden-brown ground-colour may have little to modify it except the very conspicuous black spiracles, a blackness that, in a dark specimen, extends a little beyond the spiracles, but to nothing like the extent observed in *Daphnis nerii*. The other dark markings of the abdomen are dark spots ventrally, and, on one specimen, dark shading on the flanks, as in some pupæ of *Hyles euphorbiae*, looking very like a reminiscence of the lateral stripes of *Sphinx* larvæ. The anal groove is much alike in both sexes; its sides are a little tumid, but the segment is conical with nothing of the special prominence of the Amorphid pupa; the wrinkling of abdominal segments 8, 9 and 10 is rather finer, but otherwise much the same as of the other segments. The ♂ pupa has a circular mark on segment 9, enclosing two eminences with a longitudinal depression between them. The ♀ pupa has a slight groove from the anal groove, extending to the front of the 8th segment and on the 8th on the groove two marks, similar to that of the ♂ but less pronounced; as the demarcations of the segments are much obliterated here, doubtless the posterior of these is on the 9th abdominal segment. Another specimen is rather abnormal, it has the appearance of a ♂, but with a second pore just on the incision of 8-9 (which is

elsewhere quite definite) and obscuring it merely where it is. Viewed transparently, the anterior borders of the abdominal segments show numerous pits, which are somewhat oval, with their anterior margins raised or thicker than the posterior, the margins a little crenulated (as in *Sphinx*), amongst them are a few minute hairs, most numerous near the spiracles. The black spots of the pupa cover three or four pits, and have no definite relation to them; towards the posterior margins of the segments the pits are reduced to small points, a tenth of the diameter of those in front, and approach somewhat the appearance of hair-points, each in the centre of a minute patch of darker coloration. The hairs are most numerous on the prothorax, and are both long and numerous (6 or 7 to 1 sq. mm.) near the first spiracle, some being quite 0·1mm. in length. The first spiracle has the posterior lip closely beset with extremely fine shagreen-points; the anterior lip has very numerous closely-set fine hairs, perhaps 10 to 0·1mm. each way, for 0·2mm. wide and the length of the spiracle (1·5mm.); the hairs are about 0·1mm. long where longest, they get weaker, smaller, and fade out and are lost about 0·3mm. within the opening. The true spiracle is some 1·2mm. within the outer opening. [Description made from empty pupa-shells. The colouring of Eumorphid pupæ does not alter much when they are empty but the form may be misinterpreted, since both the wing-covers and the shield-plate of the head and legs curl up a good deal in the dehisced shell. I have interpreted doubtful points by a reference to the very closely allied pupa of *Isoples alecto*, of which living specimens are available (Chapman).] Red-brown or brown-grey with blackish-grey head, dorsum and wing-cases and reddish-brown abdomen (Bartel).

Dehiscence of pupa.—The proboscis-, leg-, and antenna-cases separate together as far as the point where the wings and proboscis meet; this remains solid and retains appendage-covers in place, the headpiece separates alone (and is liable to be lost, as it is removed from between the proboscis and antennæ), these (proboscis and antennæ) stand out as a central and two lateral projections to the appendage-cases piece. Dorsally, these may be a slight accidental fracture of the margin of the prothorax, but there is no suture, and it is very slight; the mesothorax remains solid. [This seems to be the normal mode of dehiscence of Eumorphid pupæ.] (Chapman).

Foodplants. — *Vitis vinifera* (Linné), *Fuchsia* (Hellins), *Ampelopsis* (Bartel), Virginia creeper (Bell), "vigne vierge" *(? Vitis hederacea)* (Seebold). Vines which have been trained as espaliers in front of buildings appear to be preferred; much more rarely it feeds on such plants as, in addition to vine, serve *Phryxus livornica* for pabulum (Bartel); the Taro, the Nono *(Morinda citrifolia)*, the Apé *(Arum costatum)* in Tahiti (Walker), wild vine (sp. ?) in Queensland (Ash), small willow-herb, fuchsia, white bedstraw (Edgell), *Rumex lunaria* (Ragusa).

Parasites.—Many larvæ taken in April, 1901, at Townsville, in Queensland, with small marks or scars upon the dorsum. They all fed up, some spun a puparium, but none pupated, all producing, at this stage, larvæ of a rather large grey dipteron. Although hundreds of larvæ have been examimed, not a single specimen of any size has been without the telltale marks (Dodd, *Ent.*, xxxv.,

p. 44). Much subject to the attacks of ichneumons in Teneriffe (White).

HABITS.—This species abounds in most tropical and subtropical regions of the Old World, whence it spreads, in some years abundantly in others sparingly, into the temperate regions north and south. Manger has an example that was taken by Capt. Walker in the Red Sea. In Europe, it occurs sporadically as an immigrant, more often in the south, especially along the Mediterranean littoral, more rarely extending into central and northern Europe. It is recorded as having been unusually abundant in 1834, in southern France, arriving in numbers after violent south winds (Daube, *Ann. Soc. Ent. Fr.*, vi., p. 363), in August, 1846, throughout central and southern Europe, September and October, 1851, in southern France, 1854, 1859 and 1863 in France, 1865 and 1868 throughout western Europe, 1876-9 also found in France, in 1884 in Spain, and in 1885 most abundant on the Mediterranean littoral, in Spain and western Europe to the Netherlands. In August. 1846, the insect was unusually abundant throughout France and, later in the year, larvæ and pupæ were obtained, the latter usually dying and scarcely any imagines were bred. Boisduval considered this to be due to their foreign origin and inability to meet the conditions of their new environment. In 1851 it was equally abundant in southern France, but Newman observes that the dissection of the abdomina of many ♀ examples, in September and October, showed them to be empty. Seebold says (*An. Soc. Esp. Nat. Hist.*, xxvii., p. 119) that, in 1884 and 1885, the species was very abundant in Spain, the larvæ in August and the imagines in September, but that since then he had not observed it again. In 1885 it was also very abundant (so too was *Daphnis nerii*) along the Mediterranean littoral, especially in the Riviera and Sicily. In Queensland, Dodd records (*Ent.*, xxxv., p. 44) the emergence of the moths continuously in the autumn and winter months—April, May, June, and July—of 1901. at Townsville, oviposition going on all the time, the larvæ feeding up, and the imagines emerging after a pupal period of three weeks, whilst Ash notes the insect as abundant at flowers in the gardens at Southport in the spring months—September-October, so that no doubt the species is continuously-brooded here. Dodd observes that the winter-emerging examples appear to be somewhat sluggish, although the shade temperature is seldom as low as 70° F. at midday. Fully half the moths emerge between 8 a.m. and 10 a.m., the others appearing during the evening. Newnham observes that he has seen the imagines flying at dusk literally in hundreds, over the flowers of jessamine in Western India ; they only appear to come for about half-an-hour each evening, and occur about mid-June and again in September. possibly also in April, as most of the Sphingids are treble-brooded in India, and, contrary to what most books state, he has never captured this species at light, even when *Manduca atropos* and other species were coming in numbers to the argand lamps (*in litt.*). Walker observes that, at Gibraltar, the moth is not uncommon in September and October at the flowers of *Plumbago capensis*, and it is also occasionally found at rest on walls, &c., whilst at Tangier Meade-Waldo also observed them commonly in August, 1901, at the *Plumbago* bushes, the moths being very regular in their appearance, coming from 6.15 p.m. to 6.45 p.m., whilst a friend observed them

hovering round some begonia plants in pots on his verandah. Bartel notes that, in Germany, the moth does not begin to fly till it is quite dark *, *i.e.*, a good while after sundown. Its favourite flowers are *Saponaria*, *Lonicera*, *Petunia*, *Plumbago*, &c., flying at twilight around the flowers of Marvel of Peru, *Tropaeolum majus*, *T. minus*, and jasmine at Lausanne (Chaumette), at flowers of *Mirabilis jalapa* on the island of Ustica (Riggio). In Britain it has been recorded as visiting azaleas, at Alderley Edge (Keyworth), at verbenas, about 6.15 p.m., or later, between the lights, in windy weather, all flying against the wind, at Brighton (Wonfor), at petunias at Lewes (Nicholson), also at Wannock (Pearson), at Weymouth at dusk (Pretor), at Hendon, about 7 p.m. (Druce), and at Cromer (Barclay); at geraniums, near Brough (Kingston), at Christchurch (Adye), and as early as 7 p.m., at Clevedon (Mason); at Russian balsam at Ealing (Adye); at stocks and fuchsias at Lee, and near Ilfracombe (Blandford); at white trumpet-lily at Tulloch (Davidson); at gladiolus at Watchet (Fox); at fuchsias at Broseley (Newnham), and at Paul flying early in the evenings, just before 7 p.m., one was flying possibly faster than *Agrius convolvuli* (Daws), and in a greenhouse at Hamilton (Chapman); one was found at Brantingham in 1846, which had been captured by a flower of *Physanthus albicans*, the stamens of which are so placed that the slightest touch by the proboscis of an insect entering the nectary causes them and the anthers to close firmly round it (Norman, *Zool.*, p. 1863). Simon notes (*Proc. Soc. Ent. Fr.*, 1893, p. cclxxviii) an Asclepiad that has flowers capable of capturing and holding *celerio* and *capensis*. Ingram records (*E. M. M.*, 1867, p. 213) one at ivy bloom in the Isle of Wight. Durham observed an example about 7 p.m. on September 11th, 1881, whilst it was raining hard, at fuchsias in Grosvenor Square; and Frost records that it has been captured in the nurseries at Handsworth near Sheffield. In spite of Newnham's experience in India the species has often been noted at light—at Beccles, and at Brighton, at 2 a.m (Winter), at South Foreland lighthouse (Fremlin), at Chichester (Anderson), at Ashford (Viggers), at Ryde (Ingram), at Nottingham (*E. W. Int.*, ix., p 3), at Cromer (Barclay), at Taunton (Bidgood), at Sandown (Frost), at Birmingham (Enock), at Plymouth (Cregoe), at Southborough (Shepheard-Walwyn), at Tan-y-Bwlch (Kerr), at Southover, near Lewes (Blaker), in Paris (Heasler), &c., and Meade-Waldo obtained imagines, on August 14th and 26th, 1901, at Tangier, that had flown into the hall to light at about 6.30 p.m. It has also been taken at rest on a window at Sherborne (Benthall), on a shutter at Eckington (Hooke *teste* Payne), on a windowsill at 3 p.m. at Exeter (Hellins), in an iron foundry at Oldham (Taylor), on a clothes-line at Edwinstowe (Doncaster), in the street at Shanklin (Leech), on a door at Woodbridge (Graves), on a tree in an orchard at Retford (Pegler), in the brewery yard at Burton (Baker), one was swept up among dead leaves on a lawn at Eastbourne (Parsons), one fluttering in the long grass and herbage beneath a clump of fir-trees about 6 p.m., having evidently just

* Swinton, however, saw it at Jaffa in April, 1896, buzzing in the sunshine at flowering creepers on a house wall, and Oberthür has observed it flying quickly at midday, hovering at flowers in his garden at Cancale. The day-flying habit appears, however, to be unusual in this species.

emerged from pupa (Tearle), on a potting-shed at Hassock's Gate (Hanbury), a dead one taken out of a spider's web near Maxwelltown (Service). Green reports (*E. M. M.*, xxxvii., p. 90) that he found the imago to make a squeaking noise much like the well-known note of *Manduca*, at Dryalalawa in Ceylon.

Time of appearance.—In Britain, the species appears irregularly from late August to November.* Almost continuously-brooded in tropical countries†. April, mid-June, September-October in western India (Newnham); May and September in some years common in Tuscany (*teste* Bartel), in May at Tangier (Meade-Waldo), in September in Switzerland (Frey), September and October after a pupal period of 14 days, in the south also (after hybernation as pupa‡) in May and June, the winter temperature of the north being too low for the development of the hybernating pupæ (Bartel); in commencement of July and end of September throughout Europe (Boisduval), extremely rare in May-June and in September at Budapest (*teste* Bartel), June-July and September-October in the Netherlands (Snellen), in May at Meshed, in September at Goolhek (Young), in May near Jerusalem, &c. (Swinton), June and October in the Haute-Garonne (Caradja), June and September in the Dept. du Nord (Paux), in July at Ateca (Zapater), in July in Transcaucasia (Romanoff), August-October in the Loire-Inférieure (Bonjour), November in 1852 (at a temperature of 11°C.) at Wiesbaden (Bartel), September to December (from August larvæ) in Bilbao district (Bell), in Teneriffe, eggs in April, 1893 (often not till June), larvæ continuously from June until August, pupal state four weeks, imagines from September (White), September and October in the dept. Gironde (Trimoulet), imagines September to November in Spain (Cuní y Martorell), September in the Canary Islands (*teste* Bartel), August-September and October-November at Gibraltar (Walker), September and October (spring) at Southport in Queensland (Ash), also from April-July (the winter months) continuously at Townsville, in Queensland (Dodd), September in Alsace (Peyerimhoff), September and October singly in Baden (Reutti), mid-October on the east African coast at Parumbira (*teste* Bartel), abundant in 1885 in Brittany at end of summer; also very abundant throughout France in September, 1886, three taken at Rheims, imagines in August, larvæ in October at Cannes (Oberthür). The following actual dates of capture have accumulated —September 27th, 1865, September 21st, 1866, August 27th, 1867, September 13th, 23rd, 29th (two), 1868, September 15th, 1869 at Breda (Heylaerts), December 24th-29th, 1881, along the estuary

* We have carefully considered the records of appearances earlier in the year, and should want much more evidence of a reliable character to establish its appearance in Britain as early as May in this country.

† Boisduval notes (*Hist. Nat.*, p. 239) that the species cannot be looked upon as indigenous in Europe, and cannot maintain itself here. It arrives from Africa and the East in warm summers, but the progeny is exterminated in the early winter; on the other hand, in India and Africa it is continuously-brooded.

‡ There is no evidence of the successful hybernation of pupæ of this species in Europe (or elsewhere) whatever. The pupal stage appears rarely to last more than three weeks. The older authors often state that it hybernates as pupa, evidently owing to their tropical captures having beeu made in May and June, and modern authors have copied from them. Examination of the dates at disposal does not support an appearance of this species in May in Europe, except in the south, or otherwise a very occasional specimen further north.

of the Ouro on the West African coast (Mathew), November 12th, 1886, a fine male, also on August 7th, 1887, at Gibraltar (Walker), September, 1898, in a greenhouse at Les Roquettes, Guernsey (Lowe), fullgrown larvæ in early October, 1894, pupated, and several imagines emerged early in December of the same year, at Bremen (Lohmann), May, 1886, in the Lebanon (Pratt), March to May, in the Trobriand Is. (Meek), September 10th, 1899 at Sierra Leone (Meek), December 15th, 1899, at Abd-el-Kuri (Grant), April 24th, 1900, at Elmenteila (Betton). The following appear to be the only British records that we can trace*: Latter end of July, 1779, in Bunhill Fields (Harris, *Exposition*, p. 94); August, 1826, and again in 1827, near Birmingham (*teste* Stephens); imago November 4th, 1844, at Lancaster (Willan), in 1845, at Ledbury (Bree), and Huddersfield (Inchbald), commencement of October, 1845, at Seaford (Ingall), [September 1st, 1846, at Birmingham (Weaver),] September 9th, 1846, at Newton Heath (Edleston), September 24th, 1846, at Leicester (Plant),] October 1st, 1846, at Lewes (Weir), one at Brantingham Thorp (Norman), one in 1847 at Church Plain (Fitt), two in summer of 1847 at South Walsham (Frere), September 21st, 1848, at Welton (Thompson), one at Wakefield in 1849 (Sang), [two at Carlisle and one at Cockermouth in 1848 (Hodgkinson),] [May†, 1849, two examples at Harleston (Muscott),] [October 8th, 1850, at Brampton (Hodgkinson),] November, 1851, at Henley-on-Thames (Stubbs), August, 1852, at Baptist Mills (Duck), September 28th, 1885, at Rugeley (Hawkins), December 4th, 1857, an imago in fine condition on a window-sill near Bolton (Briars), second week in September, 1859, at Gainsborough (Tearle), September 19th, 1859, at Newark (Hadfield), October, 1859, at rest, at Worcester (Edmunds), September 22nd, 1860, at Nottingham (*Ent. Wk. Int.*, ix., p. 3), September 20th, 1860, at Matlock (Tearle), September 27th, 1860, at Wakefield (Talbot), [October 5th, 1860, at Beccles (Winter),] October 7th 1860, at Darlington (Beadnell), a few examples in or near Perth in 1862 and 1865 (F. B. White), [five in 1862, at Tooting (*Zool.*, 7971),] September 12th 1862, at St. Leonards-on-Sea, (*Zool.*, 8204), September 24th, 1862, near Weymouth (Pretor), September 28th, 1862, near York (*Weekly Ent.*, p. 99), October 29th, 1862, at Brighton (*Zool.*, 8295), June†, 1862, at Haslemere (Barrett), [May†, 1864, at Canterbury (Parry),] September 21st, 1864, near Alloa [possibly the same example as that recorded September 19th, 1864, at Culross (Borthwick)] (Mailler), end of July, 1865, on the Isle of Anglesea (Porritt), [September 8th, 1865, at Brighton (Winter),] September 19th, 1865, at Taunton (Bidgood), September 20th, 1865, near Brough (Kingston), September 26th, 1865, at Hendon (Druce), September 27th, 1865, at Southsea (Collins), September 28th, 1865, at Barbourne (O'Farrell), October, 1865, at Malvern (Smith), October, 1865, at Handsworth, near

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* Most of these records are obtained from the *Zoologist*, *Entomologist's Weekly Intelligencer*, *The Entomologist's Monthly Magazine*, *The Entomologist*, and *The Entomologist's Record*. Those made by professional dealers, and those about which, from the time of appearance, &c., doubt occurs, are enclosed in square brackets. It is quite possible that most of the May and June records refer to *Phryxus livornica*. There may be a few unrecorded British examples in collections, but very large numbers in British collections are doubtlessly not British.

† These records especially want confirmation.

Sheffield (Frost), October, 1865, at Waltham Abbey (Pryor), October, 1865, at Newmarket (Postans), October 19th, 1865, near Exeter (Rowdon), October 24th, 1865, at Hartlepool (Robson), autumn, 1865, at Orford, in Suffolk (Bloomfield), [October, 1865, at Witherslack, Kendal and Carlisle (Hodgkinson), June 4th*, 1866, at Kendal (Hodgkinson),] bred December 28th, 1865, from a larva, one of a brood found on vine at Worthing (Ingram), [autumn of 1867, at Carlisle (Hodgkinson),] one in 1867, at Malvern (Towndrow), in autumn, 1866, Isle of Wight (Ingram), August 28th, 1867, at Ipswich (Florrex *teste* Garrett), September 17th, 1867, at Taunton (Bidgood), September 21st, 1867, in Isle of Wight (Frost), [September, 1868, at Dover (Harding),] September 20th, 23rd, 26th, 29th and October 10th, 1868, one on each evening at Brighton (Wonfor *teste* Swaysland), September 26th, 1868, at Huddersfield (Porritt), October 2nd, 1868, at Birmingham (Enock), October 2nd, 1868, at York (Prest), October 2nd, 1868, at Camberwell (Standish), October 2nd, 1868, on Heworth Moor, near York (Dosser), in autumn of 1869, at Woodlands, Selling (Stowell), two at Middlesborough (*teste* Jagger), September 16th, 1869, a fine specimen at Weston-super-Mare (Mathew), [October 12th, 1870, at Lytham (Gregson),] July 17th. 1871, at Southport (Bell), autumn of 1872, four examples at Cromer (Harwood), mid-September, 1872, Southover, Lewes (Blaker), end of September, 1872, at Margate (Duncan), October 7th, 1872, at Brighton (Clare), September 12th, 1872, at Strood (Farrow), September 13th, 1872, at Strood (Stapleton), September 12th, 1873, on outhouse at Southport (Burton), [a ♂, October 7th, 1873, at Bolton (Hodgkinson),] one in 1873, at Ayton, in Berwickshire (Shaw), September, 13th, 1876, at Brighton (Hamlin), September 29th, 1876, at Edwinstowe (Doncaster), August, 1877, at Southsea (Lowrey), October 30th, 1877, at Eastbourne (Parsons), [May 24th*, 1878, at Alderley Edge, near Manchester (Heyworth),] first week in September, 1878, at Woodbridge (Graves), September 3rd, 1879, at Troup (Campbell), September 15th, 1879, at Gosport (Larcom), September 13th, 1880, at Kingsland (Harper, recorded *Ent.*, xiii., p. 241, as *D. livornica*), September 14th, 1880, at Oldham (Taylor), October 1st, 1880, at Chichester (Hope *teste* Anderson), October 6th, 1880, at Burton-on-Trent (Baker), October 8th, 1880, at Shanklin (Leech), October 8th, 1880, at Edenbank, near Maxwelltown (Service), October 10th, 1880, at Sheerness (Darley), about November 1st, 1880, at Edgbaston, near Birmingham (Baker), December 1st, 1880, captured at Faversham (Yearsley), September 11th, 1881, in Grosvenor Square (Durham), September 17th, 1881, at Mullaghmore (Greene), September 28th, 1883, at Stratford (Pratt), one ♂ taken at Lincoln, October 9th, 1883 (Musham), October 13th, 1883, at Gosport (Leech coll.), October 2nd, 1884, in greenhouse at West Hanney, near Wantage (Slade), November, 1884, at Retford (Pegler), November, 1884, at Berkeley (Borer), specimens, September 1st-17th, 1885, at Kenley (Venables), three specimens, September 1st-19th, 1885, at Cromer (Barclay), September 6th, 1885, at Ilfracombe (Copp), September 8th, 1885, on the wing at Wannock (Pearson), September 10th, 1885, at Christchurch, September 12th, 1885, at Ealing (Adye), September 11th, 1885, at Lewes (Nicholson), September 11th, 1885, at Blackfriars' Bridge (Goldthwaite), September

* Records especially want confirmation.

11th, 1885, at Firle (Edgell), September 12th, 1885, at Hartlepool (Robson), September 12th, 1885, at Colton (Buckley), September 12th, 1885, at Pevensey (Benson), September 13th, 1885, at Dovercourt (Kerry), September 14th, 1885, at Felixstowe (Miller), September 14th, 1885, at Holmwood, (King), second week in September, 1885, at Folkestone (Cooper), September 15th, 1885, at Walton-on-the-Naze (Wellman), September 16th, 1885, at Lee, near Ilfracombe, several at Buckfastleigh, and one also at Cambridge (Blandford), September 16th, 1885, at Crosby (Harker), one taken at Hackney, September 17th, 1885 (*teste* Clark), September 18th, 1885, at Tan-y-Bwlch (Kerr), September 18th, 1885, at Plymouth (Cregoe), September 19th, 1885, at Honnington (Hind *teste* Bloomfield), September 20th and 24th, 1885, two captured and one missed at Clevedon (Mason), two about September 19th, 1885, at Ramsgate (Wood), September 26th, 1885, at Hurstpierpoint (Meldola), September 27th, 1885, at Leicester (Rowley), end of September, 1885, at Bournemouth (Brackenbury), October 2nd, 1885, at Retford (Pegler), two in October, 1885, at Aldeburgh (Cooper), September 29th and October 8th, 1886, at Firle (Edgell), end of September, 1886, at Hastings (Gooch), August 1st, 1888, at Reading (Philbrick), October, 1888, at Chepstow (Mason), October 10th, 1888, at Portslade, near Brighton (*teste* Clark), October 1st, 1889, at West Hartlepool (Woods), November 24th, 1889, at Banbury (*teste* Stott), 1892, at Littlehampton (Fry), September 26th, 1892, at Hastings (Johnson), [October, 1892, at Brighton (Field),] October 1st, 1892, at Halifax (Halliday), October, 1892, at Harrow Weald (Rowland-Brown), October 1st, 1892, at Sherborne (Benthall), October 12th, 1892, at Nottingham (Pike), October 21st, 1892, at Ashford (Viggers), one in 1892, at Maryport (Wilkinson), August 12th, 1894, at South Foreland lighthouse (Fremlin), September, 1894, at Burnley (Sutcliffe *teste* Clutten), September 30th, 1894, at Porchester (Stares), November 4th, 1894, at Lancaster (Ralph), November 7th, 1894, at Hassock's Gate (Hanbury), September 7th, 1895, at Upper Clapton (Hanbury), September 15th, 1895, at Dover (Webb), September 15th, 1895, at Tulloch (Davidson), September 24th, 1896, at Cheltenham (Robertson), a ♀, September 4th or 6th, 1897, at Cambridge (Rickard), October 18th, 1897, at Broseley (Newnham), taken at Ewell, August, 1898 (Frohawk), September 6th, 1898, ♀ captured, another seen near Paul (Daws), September, 1898, at Les Rocquettes, in Guernsey (Bell), October, 1898, at Southborough (Shepheard-Walwyn), November 21st, 1898, at Stratford (Murray), one in 1900, at Springfield, near Gretna (Wilkinson), imago about September 25th, 1901, at Wylye (Solly), September 27th, 1902, at Emsworth (Stevenson).

LOCALITIES.—ABERDEEN: [Aberdeen (Esson),] Peterhead, Fyvie (Reid), ANGLESEA: near Menai Suspension Bridge (Porritt). AYRSHIRE: Hamilton (Duncan). BANFF: Troup (Campbell). BERKS: West Hanney, near Wantage (Slade), Reading (Philbrick). BERWICK: Ayton (Shaw). CAMBRIDGE: Newmarket (Postans), Cambridge, Ely (Jenyns), Isleham (*teste* Balding), near Wisbech (Skrimshire *teste* Haworth). CHESHIRE: Alderley Edge (Keyworth). CLACKMANNAN: Alloa (Mailler). CORNWALL: Paul, Penzance (Daws). CUMBERLAND. Cockermouth, [Carlisle (Hodgkinson),] Maryport (*teste* Wilkinson), Brampton (Morris), Keswick, several (Beadle), Lake district (Stainton). DERBY: Burton-on-Trent (Baker), Eckington (Hooke *teste* Payne), Matlock (Tearle). DEVON: Buckfastleigh, Lee, near Ilfracombe (Blandford), Lynmouth (Thornthwaite),

Plymouth (Cregoe), Ilfracombe (Copp), Exeter (Rowdon). DORSET: Oborne, near Sherborne (Benthall), Glanvilles Wootton (Dale), Encombe (Farrer, *Proc. Dorset Soc.*, vi [1885]), Weymouth (Pretor). DUBLIN: Dublin (Kirby). DUMFRIES: Springfield, near Gretna (Wilkinson). DURHAM: [Stockton (Hodgkinson).] West Hartlepool (Woods). Bishopswearmouth, Hartlepool, Durham (Robson), Darlington (Beadnell). ESSEX: Dovercourt (Kerry), Walton-on-the-Naze (Wellman), Stratford (Murray), Coggeshall (Denny), Epping (Doubleday), [Great Baddow (Greenwood)]. GLOUCESTER: Bristol, Henbury, Redland (Vaughan), Berkeley (Borer), Pitville (Robertson), Baptist Mills (Duck), Cheltenham (Merrin). HANTS: Gosport (Larcom), Southsea (Collins), Porchester (Stares), Emsworth (Stevenson), Christchurch (Adye), Isle of Wight—Shauklin (Leech), Sandown (Frost), Long Benton, Ryde (Ingram), Bournemouth (Brackenbury). HEREFORD: Hereford (Hutchinson), Ledbury (Bree). ISLE OF MAN: Douglas (Kuox *teste* Clarke). KENT: Strood (Farrow *teste* Tutt) Sheerness (Darby), Ramsgate (Wilson), Ashford (Viggers), South Foreland (Fremlin), Southborough, near Tunbridge Wells (Shepherd-Walwyu). Folkestone (Cooper), Selling (Stowell), [Canterbury (Parry),] Faversham (Yearsley), [Dover (Harding).] Margate (Duncan), Tenterden (Beale), Eltham (Latham *teste* Donovan). KINCARDINE: Banchory (Traill). KIRKCUDBRIGHT: Edenbank, near Maxwelltown (Service). LANARK: Hamilton (Chapman). LANCASHIRE: [Manchester, Prestou, Whalley, Grange (Hodgkiuson),] Oldham (Taylor), Lancaster (Willan), Carnforth (Murray), Crosby (Harker), Burnley (Sutcliffe *teste* Clutten), [Lytham (Gregson).] Southport (Bell), Bolton (Briars), Newton Heath (Edleston), Staleybridge (Chappell). LEICESTER: Leicester (Rowley). LINCOLN: Lincoln (Musham), Gainsborough (Tearle), Grantham (Walpole). MERIONETH: Tan-y-Bwlch (Kerr *teste* Arkle). MIDDLESEX: Hackuey (*teste* Clark), Harrow Weald (Rowland-Brown), Harefield (Wall), Ealing (Adye), Hendon (Druce), Waltham Abbey (Pryor), Kiugslaud (Harper), Grosvenor Square (Durham), Upper Clapton (Hanbury). MONMOUTH: Chepstow (Masou). NORFOLK: Church Plain (Fitt), Cromer (Barclay), Norwich (*teste* Stepheus), South Walsham (Frere), Harleston (Muscott). NORTHAMPTON: Peterborough (*teste* Dale). NORTHUMBERLAND: (Robson), Berwick (Carringtou), Gallowgate, Newcastle (Hancock), North Shields (Wailes). NOTTINGHAM: Nottiugham (Tearle), Edwinstone (Doncaster), Retford (Pegler), Newark (Hadfield). OXFORD: Oxford (Hope *teste* Stephens), Henley-on-Thames (Stubbs), Banbury (*teste* Stott). PERTH: rare, [a few examples] in or near Perth in 1862 and 1865, one specimeu with wings in process of expansion (F. B. White), Culross (Borthwick). ROSS: Tulloch, near Dingwall (Davidson). ROXBURGH; Cavertou district (Elliot), Hawick district (Elliot *teste* Guthrie). SHROPSHIRE: Broseley (Newnham). SLIGO: Culleenamore (Russ), Mullaghmore (Greene). SOMERSET: Clevedon (Mason), Weston-super-Mare (Mathew), Taunton (Buckland). STAFFORD: Colton (Buckley), Rugeley (Hawkins). SUFFOLK: occasional—Stowmarket, several, Orford, Honnington (Bloomfield), Woodbridge (Graves), Aldeburgh (Cooper), Ipswich (Garrett), Felixstowe (Miller), Beccles (Winter). SURREY: Kenley (Venables), Blackfriars Bridge (Goldthwaite), Ewell (Frohawk), Camberwell (Standish), Tooting (Rogers), Holmwood (King), Frensham (Bingham-Newland), Haslemere (Barrett). SUSSEX: very rare—Lewes (Weir), Brighton (Merrifield), Hastings (Gooch), Littlehampton (Fry), Aldwick (*teste* Lucas), Firle, near Lewes (Edgell), Eastbourne (Parsons), Hurstpierpoint (Meldola), Pevensey (Beusou), Portslade, near Brighton (*teste* Clark), Wannock (Pearson), Chichester (Andersou), Worthing (Ingram), Catsfield (Raynor), Seaford (Ingall), Southover (Blaker), Haywards Heath (Crallan), St. Leonards (Kent), Hassock's Gate (Hanbury). WARWICK: Edgbaston (Baker), Birmingham (Enock). WESTMORLAND: [Kendal, Witherslack (Hodgkinson),] Burton (Moss *teste* Murray). WILTS: Wylye (Solly). WORCESTER: Barbourne (O'Farrell), Tenbury (Decie), Malveru (Towndrow), Worcester (Smith). YORKS: very rare (Porritt), Brough, uear Brantingham (Kingston), Brantingham Thorp (Norman), Huddersfield (Inchbald), several in 1868 (Porritt), Middlesborough (Jagger), Wakefield (Sang), Doucaster (Stainton's *Manual*), Handsworth, near Sheffield (Frost), Heworth Moor, near York (Dosser), Darlington (Beadnell), York (Prest), Halifax (Halliday), Welton, near Brough (Thompson), Burnley district (Clutten).

DISTRIBUTION.—One of the most widely distributed species, being native in all the subtropical parts of Africa, Asia, Australia, and the Pacific islands, extending thence north and south into the temperate regions of Europe, Asia, and Africa, even reachiug the subarctic districts in its wanderings. There are probably no parts of Europe where the species is perfectly sedentary. AFRICA: Algeria—Oran (Oberthür), near Bougie (Lucas), Algiers, Sebdou (Codet),

Biskra (Bleuse), Tangier (Meade-Waldo), northwest Morocco, common (Blackmore), Morocco (Donzel), Canaries (White), Teneriffe — Oratava, not rare (Alphéraky), Madeira, West African coast—Estuary of Ouro (Mathew), Chinchoxo, Guinea, German Southwest Africa *(teste* Bartel), Bénin (Ménager), Sierra Leone (Austen), Quango-Strom (Mechow), East African coast—Parumbira *(teste* Bartel), Bourbon (Roussel), Mauritius, Madagascar, very common (Boisduval), Tananarivo (Camboué), Elmenteila (Betton), Karanga Sangwe (Grogau). Mozambique (Speyer), Natal, frequent (Spiller), Durban (Leigh), Cape Colony (Cramer), Zanzibar (Le Roy), Delagoa Bay (coll. Oberthür), Orange River Colony—Bloemfontein (*teste* Bartel). ASIA: Asia Minor—Smyrna, The Taurus (Staudinger), in the Red Sea (Manger), Lebanon (Pratt), Syria—Beyrout (Lederer), Haifä (Bartel), Persia—Meshed, Khorassan, Goolhek, near Teheran (Young), India—Coromandel coast, very common—Tranquebar, Madras (Cramer), Saugor, plentiful (Chaumette), Himalayas (Speyer), Punjaub, common (Young), Ceylon—Diyalalawa (Green), East Indies, Sumatra — Deli, Java, Moluccas, Kei Island — Toeal, Aroe Island, not rare (*teste* Bartel) AUSTRALIA: Queensland — Southport (Ash), Townsville (Dodd), New South Wales—Sydney (Speyer). PACIFIC ISLANDS: New Guinea (Koch), Mauilla (Oberthür), Tahiti (Walker), New Caledonia (Tugwell), New Hebrides, Fiji, Ellice and Gilbert Islands, &c. (Mathew), Trobriand Is. (Meek). EUROPE: AUSTRO-HUNGARY: Innsbruck, two or three times (Weiler), Pressburg, once in October, 1877 (Rozsay), Bohemia—Prague, two, August, 1846 (Nickerl), Tyrol, very rare — Botzen, Brixen (Hinterwaldner), near Salzburg, one (Nickerl), Carniola—Laibach (Speyer), Carinthia, Lower Austria—Vienna, 1846 and 1864, Moravia, Hungary, rare—Margitszigeten, Budapest, Fünfkirchen Dalmatia *(teste* Bartel). BELGIUM: not indigenous, Dinant, Brussels, Louvain one, Tournay, rather common September, 1839 (Donckier), Namur, Liège (Lambillion), Lüttich (*teste* Bartel). BULGARIA: Sofia (Bachmetjew), Varna, rare *(teste* Bartel). CHANNEL ISLES: Guernsey, two (Boley), Les Rocquettes (Bell). FRANCE: always more or less rare, commoner in the southern depts. (Berce), Paris (Heasler), Aube, occasionally, singly (Jourdheuille), Calvados, one near Caen (Fauvel), Brittany, certain years, Rennes, Cancale (Oberthür), Douai, singly (Foucart), Berry and Auvergne, occasionally (Sand), Eure-et-Loir — Châteaudun, several (Guenée), Haute-Garonne, not rare in 1854-1859, 1863, 1876-1879, 1885-1886 (Caradja), Auvergne district, great numbers in 1846 (Guillemot), Nice, frequent (Wagner), Bordeaux (Auguste), Var (Cantener), Morbihan, very rare (Griffith), Gironde—Talence, Gradignan, Mérignac (Trimoulet), Haute-Saône, Doubs—Besançon (Bruand), Aude — Carcassonne (Mabille), Loire-Inférieure, Nantes, La-Haie-Fouassière, La-Chapelle-sur-Erdre (Bonjour), Saône-et-Loire, very rare—Autun, one (Constant), Seine-Inférieure—Elbeuf, larvæ 1867, on vine (Viret), Clermont-Ferrand (Pierret), St. Quentin, occasionally (Dubus), Niort, one (Maillard), Meuse, Moselle, Meurthe district, Lyons, Digne, Hyères (Speyer), Montpellier (Daube), dept. du Nord (Paux), Rheims (*teste* Oberthür), Alpes-Maritimes, rare (Constant). GERMANY: very rare, only as an immigrant (Heinemann), southwest Germany—in 1834, 1844, 1846 and 1852 at Frankfort-on-Main (Koch), Offenbach, Hanau, Darmstadt, Giessen, larvæ and imagines (Jordan), Rhine-Palatinate, in certain years (Bertram), Würtemberg, in certain years, *e.g.*, 1846—Stuttgart, &c. (Seyffler), Giessen, one September, 1846 (Dickore), Lower Elbe district—Borgfelde, one (Zimmermann), Hesse—one in 1846 at Biedenkopf (Glaser), Mecklenburg—Wismar, one (Schmidt), Bremen—two at Oberneuland, one at Delmenhorst (Rehberg), Dresden, once or twice (Steinert), Thuringia—Mühlhausen, Gotha, a larva in 1860, Eisenach (Krieghoff), Prussia—Putzig, one, Dantzig, one (Grentzenberg), Nassau—often at Wiesbaden, *e.g.*, August 1834 and 1858 (Rössler), Grünberg, once bred, Hohenheim (Hoffmann), Brunswick, a few in 1846 (Heinemann), Hanover, a few only (Glitz), Görlitz (Moeschler), Lübeck (Paul), Heligoland (Gätke), Lüneburg, Frankfort-on-Oder, Altenburg, Münster, Crefeld, Barmen, Bavaria—Erlangen, Augsburg, once, Nuremberg (Speyer), Bremen (Lohmann), Chemnitz (Pabst), Silesia—Schweidnitz (Wocke), Pomerania—Stettin, Abtshagen, Greifswald, Stralsund (Hering), Ober-Alme, Cologne, Aix-la-Chapelle, Bonn, Magdeburg, Leipzig, Meissen, Dresden, Osterland, Minden, Elberfeld, Jugenheim, Wetzlar *(teste* Bartel), Baden—Ueberlingen, Waldshut, Lörrach, Freiburg, many in 1846, Gengenbach, Pforzheim, Carlsruhe, Heidelberg, Weinheim (Reutti), Alsace, very rare—Zabern, Strasburg, Mülhausen (Peyerimhoff), Berlin, rare (Pfützner). GREECE: Nauplia (de la Garde). ITALY: throughout, but rare (Curò), Tuscany—Lucca, in some years common (*teste* Bartel), Sicily, rare (Miuà-Palumbo), Palermo (Bellier), Isle of Ustica (Riggio), Roman Campagna—Florence, very rare (Calberla),

Lombardy, Piedmont, Liguria, Naples very rare (*teste* Bartel). NETHERLANDS: repeatedly taken, especially common in 1846 (Medenbach de Rooy), Gröningen—Friesland, Zeeland—Amsterdam, Rotterdam, several, Gelderland—Zwolle (Snellen), Breda, not rare (Heylaerts). PORTUGAL (Speyer). ROUMANIA: Bucharest (Caradja). RUSSIA: Transcaucasia—Borjom, one July, 1873 (Romanoff). SPAIN: Andalusia—common (Rambur), Teruel—Ateca (Zapater), Santiago (Macho-Velado), Barcelona - En Gracia, San Gervasio, Calella (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao (Seebold), Granada (Graslin), Gibraltar (Walker), Malaga (coll. Oberthür). SWITZERLAND: Grisons, very rare—Vicosoprano (Zeller), Berne (Meisner), Yverdon, at 1345ft. (Brown), Basle, Lausanne (Riggenbach), Freiburg, Aargau—Aarau (Boll), Oftringen (Wüllschlegel), Zürich, Wädensweil, at 1345ft. (Dietrich), Winterthur (Huguenin), Neftenbach, at 1277ft. (Kübler), near Schüppen (Rothenbach), Sargans, at 1496ft. St. Gallen, Canton Tessin (*teste* Bartel). TURKEY: Eastern Roumelia—Slivna, rare (*teste* Bartel).

Tribe: PHRYXIDI.

The Phryxid tribe is a most interesting one, and, although apparently we have now no sedentary species in Britain belonging to it, the peculiar conditions under which, at irregular periods, some of the species occur, almost certainly, as immigrants, or the direct progeny of immigrants, make their natural history of quite unusual interest. The tribe is diagnosed (*Illus.*, i., p. 124) by Stephens as:

Anterior wings not subfalcate, hinder margin rounded towards the apex; abdomen transversely banded; antennæ distinctly clavate. Larva maculated; anterior segments not retractile; caudal horn rugose. Pupa superficially buried.

Fernald, apparently basing his description on the two American species, *Phryxus lineata* and *Celerio intermedia (chamaenerii)*, gives (*Sphing. of New England*, pp. 144) the following diagnosis of the Phryxid imaginal characters:

Head of moderate size, not sunken into the thorax, smoothly scaled; proboscis as long, or nearly as long, as the body; palpi ascending close to the front, the clothing giving the end a swollen appearance; antennæ gradually and uniformly enlarging outwardly to near the end, when they are constricted suddenly into a minute bristly hook; eyes moderate in size and lashed; thorax stout, untufted, and produced considerably in front of the forewings; abdomen smooth, cylindrical, tapering rather suddenly at the terminal segments without anal or side tufts, the hinder edge of the segments armed with spinules; tibiæ not spinose, middle tibiæ with one pair of long unequal spurs, hind tibiæ with two pairs; fore tarsi with a row of stout curved spines along the outside. The forewings have 11 veins (sometimes 12), with the outer margins rounded and entire. The outer margin of the hindwings is entire, except at the end of vein 1b, where it is somewhat produced.

So far as the genera belonging to this tribe are concerned we find, as a rule, in each genus, a central species of wide distribution, around which, or from which, a few highly-specialised local sedentary species appear to have sprung. We thus have *Hyles* or "the *euphorbiae*-group," *Celerio* or "the *gallii*-group," &c. So far as the material in the British Museum and his own collection goes, Kaye has been able (*in litt.*) to formulate the following groupings in the tribe, based entirely on imaginal characters:

1. Head large, prominent, projecting; forewings long, pointed, with an oblique streak running from apex to close to base; nervures clearly marked by light scales; abdomen very tapering; front tibiæ with very strong spines and some weaker ones—PHRYXUS (*livornica*, *lineata*).

2. Head not prominent, nor markedly projecting; forewings not so long as in 1, and less pointed; forewings with oblique band from apex to near base giving off two or more short teeth or branches; spines on front tibia nearly all of uniform medium size—CELERIO (*gallii*, *chamaenerii*, *euphorbiarum*, *zygophylli*, ? *opheltes*).

3. Head closely set on shoulders, neither conspicuously large nor projecting; forewings with a more or less well-defined fascia, very broad at inner margin, with a dark discoidal blotch that nearly always lies within the fascia; spines on front tibia weak — HYLES (*euphorbiae*, *centralasiae*, *dahlii*, *mauretanica*, *tithymali*, *annei*, *robertsi*, *nicaea*, *costata*, *calverleyi*).

4. Head and tibial spines as in 3; forewings with an oblique conspicuous line dividing the wing into a lighter and darker portion; fascia spreading over almost the whole of costal half of wing area; discoidal spot distinct, black, sometimes an indication of a dark blotch—TURNERIA, n.g. (*hippophaes* (type of genus), *biguttata*, *bienerti*).

5. Head very broad, but not very projecting; forewings rather short, less pointed than in preceding sections, almost devoid of markings; a dark line sometimes present, extending from near apex to beyond middle of inner margin and much curved at nervure 2; spurs on front tibiæ in four longitudinal rows and of almost uniform size—THAUMAS (*vespertilio*).

6. Antennæ very long and very stout in ♂; forewings very dark; hindwings deep orange, with dark border reaching to margin—HAWAIINA, n.g. (*calida* (type of genus), *wilsoni*).

The general characters of the Phryxids have already been dealt with in our account of the *Eumorphinae*, and we have also given (*antea*, p. 56) a summary of the differences between the larval characters of the Eumorphids (*sens. strict.*) and the Phryxids. One point of larval structure may, however, be here noted, *viz.*, the character of tubercle v. We have, in our description of the Sphingid larva (*antea*, vol. iii., p. 367), stated the opinion that the prespiracular of the larvæ of Sphingids is not to be homologised with the subspiracular v of the larvæ of other lepidopterous superfamilies. Bacot's recent discovery, however, that, on the 1st abdominal segment of the larva of *Hyles euphorbiae* in its 1st instar, tubercle v is not only situated in the same plane as iv, but is actually conjoined to it, both the setæ arising from a small oval chitinous plate a short distance beneath the spiracle, leaves little doubt of the correctness of what we had already begun to suspect from an examination of the larvæ of *Sesia stellatarum* and *Hemaris tityus* in their earliest stadium, *viz.*, that, with further knowledge, the possibilites of homologising the prespiracular of Sphingid larvæ with the normal subspiracular v became much easier. Tubercle v, on the 1st abdominal segment of these larvæ, was found to be situated on the lateral flange, and, although still somewhat above iv, was distinctly below the level of the spiracle.

We may here refer to Weismann's detailed study of the evolution of the markings of the Phryxid larvæ (*Studies in the Theory of Descent*, pp. 223 *et seq.*). The species, with the ontogeny of which he deals, are—*hippophaes*, *zygophylli*, *lineata*, *livornica*, *gallii*, *vespertilio*, *mauretanica*, *dahlii*, *euphorbiae* and *nicaea*. He places (*loc. cit.*, pp. 223-224) these in five groups, and states that he considers the adult larvæ of these five groups represent five stages in the phyletic development of the tribe, but adds that, if the whole developmental history be taken into account, two more stages must be added, *viz.*, (1) that in which the larva possesses no particular marking (as seen in the 1st stage of development of *euphorbiae* and *dahlii*), and (2) a stage with a subdorsal line, but without any ring-spot formations. Seven stages of phyletic development must, therefore, be distinguished:

1. Entire absence of marking in adult form—(No species now seems to occur with this as the final stage of the ontogeny).
2. A subdorsal, accompanied by a spiracular line, extending from the

caudal horn to the 1st segment—(This also no longer forms the final stage of the ontogeny of any species, but is retained in the 2nd stage of *vespertilio*, *livornica*, *lineata*).

3. The subdorsal line bears a ring-spot on the penultimate segment; the other markings as in 2—*hippophaes*. (A small number of specimens show a transition to the following stage by the transference of ring-spots from the posterior to the anterior segments.)

4. Open ring-spots appear on the subdorsal line on all the segments from the 11th to the 1st—*zygophylli*, *lineata*.

5. Closed ring-spots situated on the subdorsal line—*livornica*.

6. A single row of ring-spots replaces the subdorsal line—*gallii*, *vespertilio*, *mauretanica*.

7. A double row of ring-spots—*dahlii*, *euphorbiae*, *nicaea*. (The two first-named reach this stage in the 4th stadium, *nicaea* in the 3rd.)

He adds (*loc. cit.*, pp. 199 *et seq.*), "The important differences of marking displayed by these 5 sections are not in any way accidental, but they represent different stages of phyletic development, or, in other words, the five groups are of different ages, the first (*euphorbiae*, &c.) being the youngest, and the last (*hippophaes*) the oldest of the group. According to their phyletic age, the sections follow each other in inverse order, the first being *hippophaes*, the second that of *zygophylli*, the third that of *livornica*, the fourth that of *gallii*, the fifth and youngest that of *euphorbiae*." Weismann, however, does not accept these as the natural sections into which the Phryxids fall, *e.g.*, he assumes *lineata* to be a generalised form of the more specialised *livornica*, whilst *zygophylli* is a terminal species on the same phyletic plane as *lineata*, and again he considers *gallii* and *vespertilio* as terminal forms, whilst *mauretanica*, in the same plane, is considered merely a phyletic stage in the development of *dahlii*, *euphorbiae* and *nicaea* (see *loc. cit.*, diagram, p. 358). His groupings, therefore, work out as: (1) *hippophaes*, (2) *zygophylli*, (3) *lineata*, *livornica*, (4) *gallii*, (5) *vespertilio*, (6) *mauretanica*, *dahlii*, (7) *euphorbiae*, *nicaea*. In spite of the fragmentary knowledge we possess of the history of the larvæ of most of the Phryxid species, Weismann considers (*loc. cit.*, pp. 225 *et seq.*) that the development of the markings has proceeded in the same manner in all the species. He points out that (1) the species all appear to be making for the same goal, (2) the young larval forms of a species never show the markings of a later phyletic stage than the older larval forms, (3) development takes the same course in all species, only making a greater advance in the same direction in some than in others, *e.g.*, *nicaea* and *euphorbiae* have advanced to the 7th phyletic stage, *zygophylli* and *hippophaes* only to the 3rd, and some specimens of *zygophylli* to the 4th, but, at whatever phyletic stage the ontogeny of a species may terminate, the young larval instars always display the older phyletic stages. Thus, *gallii* in its last ontogenetic instar reaches the 6th phyletic stage, in its penultimate instar it reaches the 5th phyletic stage, and in its 3rd instar the 4th phyletic stage is represented, so that little imagination is required to anticipate that, in the 2nd instar, the 3rd or 2nd phyletic stage would be pictured. The ontogenetic instars may represent a continuous series of phyletic steps, *e.g.*, *gallii*, or certain steps may be omitted, *e.g.*, *euphorbiae*. The suppression of phyletic steps increases with the advancement in phyletic development, the higher the step to which the species finally attains, the greater is the tendency of the initial

stages to be compressed or omitted altogether. He concludes, from a study of the larvæ of *hippophaes* and *gallii*, that the Phryxid ring-spots first originated on the segment bearing the caudal horn, and that they were then gradually transferred as secondary spots to the preceding segments.

Weismann argues (*loc. cit.*, p. 228) that there is a fundamental difference between the development of the markings in Eumorphid and Phryxid larvæ. In the former the formation of the eye-spots proceeds from a subdorsal line, but they first appear on two of the front segments, and are then transferred to the posterior segments. In the latter, on the other hand, a single ring-spot is formed on the penultimate * segment bearing the caudal horn, and this is repeated on the anterior segments by secondary transference. With respect to the origin of the ring-spots also, there is a distinction between the Phryxids and Eumorphids, inasmuch as the first step towards the eye-formation in the latter consists in the separation of a curved portion of the subdorsal line, whilst, in the former, the nuclear spot first seems to originate, and the separation of the mirror-spot from the subdorsal line appears to occur secondarily. . . . . In the Eumorphids, also, the formation of the primary eye-spots appears to differ from that of the secondary—in the latter the black "ground-area" first appears, and in the former the "mirror-spot." The secondary eye-spots certainly remain rudimentary in this group, so that the evidence in support of this conclusion is thus much weakened. As a final result, Weismann advances the opinion that the Phryxids dealt with have reached five different phyletic stages, and that their very different external appearance is explained by their different phyletic ages, and he says that the appearance, from such different larvæ, of moths so extremely similar, can otherwise be scarcely understood. He urges that the variations which occasionally occur in the larvæ furnish, to a certain extent, a proof of the correctness of the theoretical interpretation offered. Thus, forms reverting to an earlier phyletic stage occasionally occur, *e.g.*, traces of the subdorsal line in the adult larvæ of *euphorbiae*, as illustrated in one of Hübner's figures, marked as an "aberration," a similar specimen also being in the Staudinger coll., whilst in adult larvæ of *vespertilio* this line appears more frequently, and Staudinger observes that, among several hundred adult larvæ of *dahlii* found in Sardinia, there were some which did not possess a distinct subdorsal line, but, in place thereof, and, as its last indication, a feeble light stripe, whilst one showed also a distinct line between the closed eye-spots. As might be expected, a larva in any ontogenetic stage most readily reverts to the preceding phyletic stage, so that those characters present in the preceding stage are those that most commonly arise by reversion. Larvæ of *euphorbiae* in the last stadium frequently take on the 6th (with a single row of ring-spots) instead of the 7th (with a double row of ring-spots) phyletic stage, whilst reversions to the 5th phyletic stage (a single row of ring-spots with connecting subdorsal line) are very rare. These larvæ which, in the adult instar, belong to the 6th phyletic stage, not infrequently show the characters of the 5th stage more or less developed, *e.g.*, *vespertilio*.

* Weismann calls the 8th abdominal the "penultimate" segment throughout his descriptions.

We do not know that anyone has attempted to really challenge the view propounded by Weismann, but Chapman points out *(in litt.)* that the larval evolution as here set forth exhibits some hiatus and possibly some mistakes. After noticing that Weismann's idea (that the primitive Eumorphid larva had a pale subdorsal line, much as have the larvæ of *Hemaris* and *Sesia*, and which is still essentially present in *Darapsa*) may be accepted, he goes on to urge that it was somewhere below *Darapsa* that the Eumorphid stirps divided into two sections:

Sect. 1. PHILAMPELINA.—This branch seems not to have developed eye-spots on the abdominal segments in the subdorsal line of larva, but to have retained the line, and often to have developed oblique stripes in the reverse direction to those in *Sphinginae—Philampelus, Dupo, Pachylia, Dilophonotus. Acosmeryx, &c.*

Sect. 2. EUMORPHINA.—This branch did develop larval eye-spots in the subdorsal line on the abdominal segments of the larva. Of this group *Darapsa* (*myron*) may be taken as a basal form—*Eumorpha, Theretra, Hippotion, &c.*

Sect. 1 includes all the non-Eumorphine Eumorphids, and no doubt contains several tribes of equal value with *Eumorphina*, yet this broad subdivision thoroughly agrees with the pupal indications. *Darapsa* is not only about as low pupally as *Hemaris* or *Pterogon*, but is almost certainly lower than the best known Eumorphids and Philampelids. Starting from this point *(Darapsa)*, which is, from the standpoint of larval morphology, fairly common to the lower members of all the Sphingid subfamilies,* the Eumorphids began to develop eye-spots along the subdorsal pale line. Weismann's account of how the simple pale line gradually develops into an eye-spot leaves nothing to be desired. From this point there are, as he points out, several attractive hypotheses possible, though he does not refer to the alternative ones till he has well enlisted our sympathies in favour of the one he adopts, *viz.*, that two branches occurred here, in one of which the eye-spots originated on the anterior segments, and were here carefully elaborated for terrifying purposes on the 1st and 2nd abdominal segments *(elpenor, porcellus)*, whilst, in the other, the eye-spot originated on the 8th abdominal segment (for what object he leaves unelucidated), but, in each instance, as a final stage, passing to the other abdominal segments, yet arising in totally different ways. A difficulty is here obvious, although it has to be conceded that the two divisions he makes correspond with the two natural tribes—*Eumorphidi* (with retractile front segments, and cryptic coloration, terrifying markings and attitudes) and *Phryxidi* (with much less retractiie front segments, a conspicuous warning coloration, and no terrifying attitudes). The difficulty is in explaining why such remarkably similar markings, in such closely-allied tribes, should separately originate for such very different objects. Such markings, originating in a subdorsal line, are elsewhere certainly very rare, if not unknown, and one is almost compelled to believe that, with such different objects in view, the necessary markings would have resulted in totally different forms, because they would have originated in totally different ways. The difficulty can only be got over by supposing that the tendency to develop eye-spots was well expressed before the two branches

* The still lower stage of "no markings" suggested by Weismann is quite outside *(i.e.,* below) the Sphingides (Chapman).

separated. This view becomes almost a certainty when we find that really the only argument of any weight in support of the separate origin of the Phryxid markings is based on the view that *Turneria hippophaes* is the lowest of the Phryxids, and that the eye-spots are there appearing, whilst there can be little doubt that it is really one of the last evolved, and is eminently specialised to suit its surroundings. The Eumorphid larvæ, which Bacot asserts are the primitive Sphingids, like those of Hemarids and Sesiids, are feeders on low-growing plants, and this is especially true of the Phryxids, of which, however, *T. hippophaes* is an exception, and may be supposed to have taken to a shrub comparatively recently; its imaginal colouring is also quite specialised (possibly for hiding on sand or among the leaves of its foodplant), so that its colouring is less like that of Eumorphids, and of Sphingids generally, than almost any other species of the group. It is very safe to assume, then (a suggestion that did not escape Weismann, but which he rejected), that *hippophaes* is derived from a form like *euphorbiae*, and not *vice versâ*. This conclusion is supported by the pupal evidence, which shows *hippophaes* to be, if anything, a shade in advance of *euphorbiae* instead of very decidedly below it, as, if Weismann's theory were correct, it ought to be. This brings us to what appears to have been the real line of evolution of these eye-spots, *viz.*, that they originated in a tendency of the pale line to break up into eye-spots all along the abdominal segments, and possibly more pronounced at one place than another, but certainly not reaching any such development as we find in *Theretra (porcellus)*, highly evolved on one segment before appearing on another. Their first development was probably encouraged by a gain being made towards inconspicuousness by breaking up the large uniform areas; then the division into two groups occurred, as these spots, so soon as they reached any definite development, presented two new but very different kinds of usefulness. Of these, the Phryxids are in tolerably uniform series, both larvally and pupally, and present few difficulties, except such as that of *hippophaes*, and, perhaps, a few others, if we had a fuller knowledge of typical forms. They did not subdivide into several distinct branches of any length. They do, indeed, rather trouble one to decide precisely which are the higher and which the lower, rather, however, from their being so close together than on account of their presenting puzzling and antagonistic characters, and, *zygophylli*, *hippophaes*, *vespertilio* and *nicaea* would probably be terminal species of different divisions, whilst pupally, *livornica* is certainly the highest and most elaborated. Except for the position assigned to *hippophaes* this is substantially the same phylogenesis as is given by Weismann (*loc. cit.*, p. 358), though this one change makes it look very different, as perhaps essentially it is.

We return now to the *Eumorphidi*, which contains of British species — *elpenor* and *porcellus* (practically identical for broader phylogenetic questions) and *celerio*. This is a tribe really much more numerous in tropical regions than the *Phryxidi*; unfortunately, for this reason, we know less about it. Weismann recognised two divisions beyond the basal *Darapsa*: (1) With eye-spots on

the first two abdominal segments—*elpenor*, *celerio*. (2) With eye-spots repeated on all the segments. Of these, he makes the first the lower. Besides the objection to this order, already noted, it may be added that those with the complete series usually have them of approximately the same value throughout, as though they had all developed together, *pari passu*, with each other, at least the second spot is usually fairly in line with all the following ones. Had they arisen from an *elpenor*-form the first two must have receded, whilst the others advanced. This seems a very unlikely thing to happen. Weismann makes no reference to the forms with one eye-spot only on the 1st abdominal. Other difficulties might be raised from Weismann's arrangement, *e.g.*, the varying intensity of the eye-spots when occupying all the segments, from merely faint indications to completely developed eye-spots, nearly identical throughout the length of the larva, going far to show that they were all developed together, others in which the forward eye-spots are best developed, quoted by Weismann (*Lilina bisecta*) as showing the gradual extension of the eye-spots backwards, illustrates the gradual loss of all but the forward spots. There is, apparently, no larva with 3, 4, 5 or 6 spots, nothing between 1 or 2 on the one hand, or 7 on the other. It is, however, perhaps, better to insist pointedly on an instance that Weismann himself would certainly admit to prove that a complete row of spots preceded their more localised specialisation. In Weismann's *Studies*, &c., transl. p. 194, Meldola describes the adult larva of *Florina japonica* as possessing the two (and only two) forward eye-spots as in *Eumorpha elpenor*. In the *Tijdschrift*, vol. xl, Piepers figures the young larva of this species as possessing a complete row of eye-spots. With a greater knowledge of exotic forms, doubtless many other such instances would be forthcoming, but one is as good as a dozen, since there is no reason that I can discover to believe we have here any exception to the rule on which Weismann so much insists, and which generally holds good, of the earlier stages representing ancestral conditions. Taking it then as proved by this instance, for Weismann adduces nothing but what is mere plausible matter of inference in support of his own conclusion, that the initial Eumorphid character was a continuous row of eye-spots, it becomes extremely probable that this state of the evolution of the markings was possessed by the common ancestor of the Phryxids and Eumorphids. It follows from this that the distinction between Phryxids and Eumorphids is not so deep and fundamental as it would be, if Weismann's theory were correct. My own view, founded on pupal characters, was at first very close to Weismann's as regards the position of *E. elpenor* and *Theretra porcellus*, *viz.*, that they were very low in the group. In concluding from the larval evidence that they are, on the contrary, at one of the highest points the pupal indications have to be reviewed. I may say the imaginal evidence also, for these species are certainly much less specialised than such species as *Hippotion celerio* or *Isoples alecto*. It is necessary here to repeat that, in dealing with such questions as these, one must keep oneself well in hand and remember that these species are not to be got into a lineal arrangement; a tendency to do this always besets one, if one be not continually on the alert, and one sees the results in many

of the theories of the phylogenesis of different groups which are from time to time afforded us. It is quite natural to find *T. porcellus* to be imaginally the lowest, and larvally the highest, of the group. Being imaginally the lowest, it cannot be descended from, say, *H. celerio* or *I. alecto*, though the larval evidence says it might be; nor can *I. alecto* be descended from *T. porcellus* though the imaginal evidence says it might be. The common ancestor must be one as low larvally as *I. alecto*, as low imaginally as *T. porcellus*. Since leaving that common ancestor, which may have been more, but could not have been less, primitive than the one we have just outlined, *T. porcellus* has used the interval in specialising its larva, and in specialising its pupa for locomotion, but, in other respects, has not much advanced its pupa and has left the imago, altered it may be, but if so, very little, in the directions which we regard as advance and specialisation in the *Sphingides*. Such species again as *Pergesa acteus* or *I. alecto* have advanced to a high point as pupæ and imagines, but have retained the early larval arrangement of a full series of spots. There is sufficient indication in both *Sphingidae* and *Amorphidae* of this row of spots to suggest that it arose amongst the primitive Sphingids before the first definite division into the subfamilies we now recognise. The relationship between these Eumorphid larvæ would appear to be something near to the following rough tabulation:

A. A primitive larva as in *Darapsa myron*, plain subdorsal line, no retractile front segments beyond what nearly all larvæ, and especially Sphingid larvæ, have more or less (Primitive Eumorphids).

B. A larva precisely like *A*, but with primitive eye-spots along *all* the segments, not quite so advanced as Weismann's "open ring-spot," fig. 50A.

C. A larva like *B*, but with ring-spots rather more advanced than 50A, more like those of *Thaumas vespertilio* (Weismann, fig. 14) (Primitive Eumorphine).

From *A* would also descend the primitive *Elegantes* (Hübner, *antea*, vol. iii., pp. 350-351) including *Philampelus*, *Dupo*, *Pachylia*, *Dilophonotus*, and probably *Nephele;* from a larval point of view, even the more definitely Sesiine forms would descend from *A*. There is, indeed, no very strong line by which to divide Sesiids from Eumorphids. The difficulty here is very great to define *Philampelus* from *Daphnis*, *Daphnis* from *Argeus* and *Argeus* from a typical Eumorphid (*porcellus*, &c.). It seems necessary to assume that somewhere between *A* and *C*, these (and allied genera) separated before the stirps became definitely Eumorphine. It follows from this that *Darapsa myron*, being really Eumorphid, must have progressed with the Eumorphines as far as *C*, or even on the Eumorphid side, and then reverted (as regards its larva) to the more primitive form so far as eye-spots are concerned, but not quite reaching the really primitive Sesiine larva, some of which, however, are also specialised in various Elegantine (Philampelid) directions. From *C* we find two branches, the Phryxids and Eumorphids:

1. More or less preserving all the spots, using them as parts of a warning coloration, and not developing retractile segments.
2. Developing retractile segments, and with them specialising the anterior spots as eye-spots.

On this special Eumorphid branch the eye-spots became confined to the first 7 abdominal segments, and probably reached first a form now best seen in *Isoples alecto*, *viz.*, *all* the spots nearly equal in size and importance. This larva seems also to be less

specialised in the front segments, being less retractile than in, say, *Theretra porcellus*. A form precedent to this is probably preserved by *Xylophanes oldenlandiae* which has a spot on the 8th abdominal segment, not quite obsolete, although the first two are already well-specialised. No Eumorphid (as distinct from Phryxid) appears to have an eye- or ring-spot on thoracic segment.* *X. oldenlandiae* also has† (according to figures) less retractile front segments than other Eumorphids. *X. oldenlandiae* thus preserves a primitive Eumorphid character, though, otherwise, both it and *Isoples alecto* are specialised in the groups they represent, larvally, as well as in the pupal and imaginal instars. *I. alecto*, with a complete row of well-developed eye-spots, is probably as far from the primitive Eumorphid with a complete row of ring-spots (as in young *Florina japonica*) as is *Pergesa acteus* with them differentiated, or *Hippotion celerio* with only two left; and it is perhaps misleading to take it as representing this stage of the evolution. The next stage is the decline and disappearance of the later spots, leaving only one or two. Weismann does not say whether those with two spots originated from those with one or *vice versâ*, neither view fits in well with his general theory. We have: (1) Larva with the 1st spot larger than the others, passing on to forms with only the 1st spot, this becoming more dorsal and ending dorsally. (2) In others the 2nd spot persisted as well as the first, and culminated in such forms as *Hippotion celerio* and *Theretra porcellus*. It does not follow that the species we now have are related to one another in this larval order; *H. celerio* and *T. porcellus*, for instance, that have reached a nearly identical point, probably left the main stem separately, *T. porcellus* not very far from *I. alecto* (larvally), *H. celerio* at some distance above. Section *C*, as defined above (p. 143), branches as follows:

1. Same as *C*, but eye-spots persisting somewhat on thorax and on 8th abdominal, but no retractility—Phryxids.
2. Same as *C*, but eye-spots restricted to 7 first abdominal segments (8th in *X. oldenlandiae*), and retractility of front segments appearing—Eumorphids.

    a. Eye-spots nearly equal on 8 abdominal segments—*X. oldenlandiae*.
    b. Eye-spots nearly equal on 7 abdominal segments—*I. alecto*.

    c_1 Eye-spots waning on abdominal segments 2-6—*D. tersa*, *P. acteus*, *H. clotho*, *L. bisecta*.
    d_1 Eye-spots lost on abdominal segments 2-6—*P. vigil*, *mydon*.

    e. Eye-spots moving dorsally—*lucasi*.
    f. Eye-spots combined on dorsum—*Elibia*.

    c_2 Eye-spots waning on abdominal segments 3-6, difficult to distinguish, if really different, from *c*.
    d_2 Eye-spots lost on abdominal segments 3-6.
        α. Earlier form—*E. elpenor*.
        β. Later form—*H. celerio*.

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* Piepers figures a larva of *Florina japonica*, with a thoracic spot, possibly, however, an error on the part of the artist (Bacot).

† The larva of *X. oldenlandiae* is figured by Moore (*Cat E. I. Mus.*, pl. xi.) as having 8 equal spots, and almost identically by Piepers (Tijdschrift, vol. xl., pl. i.). Two blown larvæ, in the Brit. Mus. coll., referred to this species, have the first two spots well differentiated, and in one there is no 8th spot, whilst, in the other, the 8th spot is distinctly a spot, but not as well-developed as the five in front of it (Chapman).

Bacot points out *(in litt.)* that the imagines of two closely allied species, one of which inhabits temperate and the other tropical districts, or even two forms of the same species, may differ much in the greater size of the head and the more prominent eyes in the tropical form. He instances the Indian *Hyles lathyrus*, which Staudinger says is hardly distinguishable from *H. nicaea* in pattern, and which has been referred by himself and other authorities to *Hyles euphorbiae* as a variety, as having much larger and more prominently situated eyes than the latter species, whilst the length of head and the form of the abdomen are also noticeably different. This variation amounts to a greater difference than exists between say such distinct species as *Hyles euphorbiae* and *Celerio gallii* from European districts. He points out that this must be largely associated with habit, and notes that the Sphingids fly at twilight in temperate regions, whilst, in the tropics, there is no real twilight, and the tropical Sphingids, therefore, must fly in the dark. To collect the necessary light rays, a larger eye surface, more prominent eyes and a longer head follow as a necessary consequence, whilst the large number of flowering trees and tall climbing plants, with the flowers situated on or above the plane of flight in tropical countries, in contradiction to the low-growing plants whose flowers, below the plane of flight, are so freely visited in temperate regions, may also have considerable influence as regards the position of the eyes upon the head, a more dorsal position being necessary in the more marked tropical forms and a more ventral aspect in the temperate ones. One would also suppose that greater powers of flight are required, owing to their having to escape the attacks of larger and swifter bats and night-flying birds, and, perhaps, also, to the absolute necessity of hovering owing to the larger size of the flowers.

Genus: PHRYXUS, Hübner.

SYNONYMY. — Genus: *Phryxus*, Hb., "Verz.," p. 137 (*circ.* 1822); Stephens, "Ill. Haust.," iv., app. p. 5 (1835); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, Esp., "Schmett. Eur.," ii., pp. 87, 196, pl. viii., fig. 4, pl. xlvi., figs. 3-7 (1779); Berg., "Sphing. Larv.," p. 8 (1782); Fuess., "Archiv," vi., p. 15, pl. xxxiii (1785); Bork., "Sys. Besch.," ii., pp. 83, 141, 179 (1789); Rossi, "Faun. Etr.," ii., pp. 14, 359 (1794); Panz., "Faun. Ins. Germ.," ii., p. 21 (1794); Hb., "Eur. Schmett.," figs. 65, 112 (1796); text p. 96 *(circ.* 1805); Don., "Brit. Ins.," vi., p. 59, pl. cciv., fig. 1 (1797); Schrk., "Faun. Boica," ii., 1, p. 225 (1801); Haw., "Lep. Brit.," pt. 1, p. 60 (1803); Latr., "Hist. Nat.," xiv., p. 132 (1805); Shaw & Nodder, "Viv. Nat.," xvii., pl. 724 (1806); Ochs., "Die Schmett.," ii., p. 214 (1808); Leach, "Edinb. Encycl.," ix., p. 130 (1815); Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," iii., p. 40, pl. xviii., fig. 1 (1822); Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); Meig., "Eur. Schmett.," ii., p. 136 (1830); Evers., "Faun. Volg.-Ural.," p. 111 (1844); H.-Sch., "Sys. Bearb.," ii., p. 86 (1846); Speyer, "Geog. Verb.," i., pp. 320, 461 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," i., p. 146 (1859). *Phinx*, Fuess., "Archiv," i., pl. iv., figs. 1-4 (1781). *Deilephila*, [Lasp.,] "Jena. Allg. Lit. Zeit.," iv., p. 100 (1809); Ochs., "Die Schmett.," iv., pp. 42, 43 (1816); Hb., "Franck Cat.," p. 87 (1825); Stphs., "Illus.," i., p. 126, pl. xii., fig. 1 (1828); "Cat. Br. Ins.," ii., p. 32 (1829); Bdv., "Icones," pl. v., figs. 3-4, pl. 77, figs. 2-3 *var.* (*circ.* 1840); "Hist. Nat. Sphing.," p. 172 (1875); Dup., "Hist. Nat.," supp. ii., p. 159 (1835); "Cat. Méth.," p. 42 (1844); Dunc., "Brit. Moths," p. 152 (1836); Wood, "Ind. Ent.," p. 16 (1839); Humph. and Westd., "Brit. Moths," i., p. 19 (1841); Dbldy., "List. Br. Lep.," p. 3 (1847); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Walk., "List," &c., viii., p. 164 (1856); Sta., "Man.," i., p. 94 (1857); Humph., "Gen. Brit. Moths," p. 10, pl. ii., fig. 5 (1860); Staud., "Cat.," ed. 1, p. 16 (1861); 2nd ed., p. 37 (1871); 3rd ed., p. 103 (1901); Ramb., "Cat. Lép. And.," p. 131 (1866); Berce, "Faun. Franç.," ii., p. 22 (1868); Newm., "Brit. Moths," p. 9 (1869);

Mill., "Cat. Lép. Alp.-Mar.," p. 118 (1872); Cuní y Mart., "Cat. Lep. Barc.," p. 39 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 111 (1875); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 568 (1876); Kirby, "Eur. Butts. and Moths," p. 71 (1879); "Cat.," p. 664 (1892); Frey, "Lep. Schweiz," p. 57 (1880); Weism., "Stud. Theory Descent," transl. p. 201 (1882); Buck., "Larv.," ii., p. 42, pl. xxv., fig. 1 (1887); Auriv., "Nord. Fjär.," p. 46 (1889); Minà-Pal., "Nat. Sicil.," vii., p. 134 (1888); Barr., "Lep. Brit.," ii., p. 46, pl. 50 (1895); Meyr., "Handbk.," p. 296 (1895); Lucas, "Brit. Hawk Moths," p. 99 (1895); Tutt, "Brit. Moths," p. 27 (1896); Leech, "Trans. Ent. Soc. Lond.," p. 285 (1898); Bartel, "Pal. Gross-Schmett.," ii., p. 98 (1900). *Phrynus* (by error for *Phryxus*), Stephs., "List Br. An. Brit. Mus.," p. 28 (1850). *Dilephila*, Hamps., "Moths of India," i., p. 98 (1892); Kirby, "Handbook, &c.," iv., p. 27 (1897).

The genus is diagnosed (*Verzeichniss*, &c., p. 137) by Hübner as follows:

The forewings almost entirely white-nervured; the body on the back and on the sides chequered with black and white—*Phryxus livornica*, Pet.* (*lineata* Fab.), *P. caicus*, Cram.

In 1835, Stephens placed this species in his "Abstract of the Indigenous Lepidoptera contained in the *Verzeichniss Bekannter Schmetterlinge*" (*Illus. Haust.*, app. p. 5) as the British exponent of Hübner's *Phryxus*. In 1850, he placed it in the same genus (*List of Specimens of Brit. Animals in Coll. of Brit. Museum*, pt. v), but the name is, by a printer's error, misspelt *Phrynus*. The genus has been diagnosed (*in litt.*) at length by Kaye as follows:

Forewing triangular, pointed sharply at apex; exterior margin very slightly convex, not indented. Cell extending half the length of wing, nervures 7, 8 on a long stalk, 6 from upper angle. Cross-nervure very oblique and slightly curved; nervure 5 slightly nearer 4 than 6; nervure 2 two-fifths from base; 1*b* greatly curved up after leaving base and returning to extreme angle at tornus. Hindwing rather short and broad, apex very bluntly pointed; exterior margin recurved and bluntly pointed at anal angle; cell scarcely extending more than one-third length of wing; subcostal spur emitted at less than half the length of cell; 6 and 7 from upper angle, 6 almost straight. Discocellular flattened, S-shaped, with both curves about equal; nervure 3 from close to 4, 2 from half the length of cell. Palpi blunt. Antennæ with pectinations very weak, consisting only of a few hairs—*Phryxus livornica*.

Weismann shows (*Studies in Theory of Descent*, p. 200) that *livornica* and *lineata* (referred by Staudinger, *Cat.*, 3rd ed., p. 103, to the same species) fall in separate groups when considered from the point of view of larval development. From this standpoint he differentiates them as having:

Open ring-spots† appearing on the subdorsal line on all the segments from the 11th to the 1st—*lineata*.

Closed ring-spots situated on the subdorsal line—*livornica*.

Later, however, he shows (*loc. cit.*, p. 358) that he considers the larva of *lineata* to be an ancestral stage on the same line of descent as that of *livornica*, the former being the more generalised, the latter the more specialised, member of the same genus. The pupa of *P. livornica* differs from the other Phryxid pupæ known to us in being much more like that of *Hippotion* than they are. It has a certain amount of antero-posterior flattening, whilst the other Phryxids are fairly round; it also shows some S curve owing to ventral lengthening of abdominal segment 4, the others being fairly straight; the maxillary keel is long and thin, extending round front of head,

* This was the *Accipitrina livornica* of Petiver, 1702. The name, however, has no standing on Petiver's authority, being antecedent to 1758, the earliest date accepted for binomial nomenclature.

† Fernald's description (*posteà*, p. 150) suggests that certain forms of this larva may reach or even surpass that of *livornica* in the development of its ring-spots.

making the labrum dorsal; the anal spike is comparatively slender and short. All these are rather Hippotionid than Phryxid characters. As a character of its own it has the rough prespiracular area of 5, 6 and 7 much more extended than in any other Phryxid, or indeed any other Sphingid, pupa I know. The texture is Phryxid, but its sculpturing is more pitting than in other Phryxids, which one would hardly expect, since it appears to be in pupal development the most advanced of them (Chapman).

The following is our own general diagnosis of the genus (as restricted to *livornica* and *lineata):*

IMAGO: Head large, prominent, projectiug; forewings long, pointed, with an oblique streak running from apex to close to base; nervures clearly marked by light scales; abdomen very tapering; front tibia with very strong spines and some weaker ones. PUPA: Labrum anterior; keel well-developed; sculpture largely pitting. LARVA: Of typical Phryxid outline, with a single row of open or closed ring-spots on the subdorsal line.

It is a most restricted genus, with only two species, *livornica* and *lineata*, but these have an almost world-wide distribution, the former occurring almost throughout the whole of the Old World, including Australia, and the latter, a great part of the New World, including the Pacific Islands.

PHRYXUS LIVORNICA, Esper.

SYNONYMY.—Species: *Livornica*, Esp., "Schmett. Eur.," ii., p. 196, pl. xlvi., figs. 3-7 (1779); Hb., "Eur. Schmett.," pl. xii., fig. 65, pl. xxiii., fig. 112 (1796); text p. 96 *(circ.* 1805); "Larv. Sphing.," iii., Legit., B, c.f., 1 *a-c (circ.* 1800); "Verz.," p. 137 (1822); "Franck Cat.," p. 87 (1825); Stphs., "Cat. Br. Ins.," ii., p. 32 (1829); "Ill. Haust.," iv., app. p. 5 (1835); "List Br. An. Br. Mus.," p. 28 (1850); Wood, "Ind. Ent.," p. 16 (1839); Humph. and Westd., "Brit. Moths," i., p. 19 (1841); Walk., "List," p. 164 (1856); Sta., "Man.," i., p. 94 (1857); Humph., "Gen. Brit. Moths," p. 10, pl. ii., fig. 5 (1860); Staud., "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 37 (1871); Berce, "Faun. Franç.," ii., p. 22 (1868); Newm., "Brit. Moths," p. 9 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 118 (1872); Curò, "Bull. Soc. Ent. Ital.," vii., p. 111 (1875); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 568 (1876); Kirby, "Eur. Butts. and Moths," p. 71 (1879); "Cat.," p. 664 (1892); "Handbook," &c., iv., p. 27 (1897); Weism., "Studies Theory Descent," transl. p. 201 (1882); Buckl., "Larvæ," &c., ii., p. 42, pl. xxv., fig. 1 (1887): Minà-Pal., "Nat. Sicil.," vii., p. 134 (1888); Auriv., "Nord. Fjär.," p. 46 (1889); Hofm., "Raup. Schmett. Eur.," p. 29, pl. vii., fig. 8 (1893); Schmett. Eur.," p. 30, pl. xvii., fig. 18 (1894); Barr., "Lep. Brit.," ii., p. 46, pl. l (1895); Tutt, "Brit. Moths," p. 27 (1896); Hamps., "Ind. Moths," i., p. 97 (1892); Leech, "Trans. Ent. Soc. Lond.," p. 285 (1898); Bartel, "Pal. Gross-Schmett.," ii., p. 98 (1900). *Celerio* var., Esp., "Schmett. Eur.," p. 87, pl. viii., fig. 4 (1779). *Koechlini*, Fuess., "Archiv," i., pl. iv., figs. 1-4 (1781); vi., p. 15, pl. xxxiii., figs. 1-5 (1785); Bork., "Sys. Besch.," ii., pp. 83, 141, 179 (1789); Schrk., "Faun. Boica," ii., 1, p. 225 (1801). *Koechliniana*, Bergstr., "Sphing. Larv.," p. 8 (1782). *Lineata*, Rossi (*nec* Fab.), "Faun. Etr.," ii., pp. 14, no. 359 (1794); Panz., "Faun. Ins. Germ.," ii., p. 21, no. 14 (1794); Don., "Brit. Ins.," vi., p. 59, pl. cciv (1796); Haw., "Lep. Brit., i., p. 60 (1803); Latr., "Hist. Nat.," xiv., p. 132 (1805); Shaw and Nodder, "Viv. Nat.," xvii., pl. 724 (1806); Ochs., "Die Schmett.," ii., p. 214 (1808); iv., pp. 42, 43 (1816); Leach, "Edin. Encycl.," ix., p. 130 (1815); Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," iii., p. 40, pl. xviii., fig. 1 (1822); Stphs., "Ill. Haust.," i., p. 126, pl. xii., fig. 1 (1828); Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); "Gen. et Ind. Meth.," pl. v., figs. 3-4 (1840); "Hist. Nat. Sphing.," p. 172 (1875); Meig., "Eur. Schmett.," ii., p. 136 (1830); Bdv. Rbr. et Grasl., "Sphing.," pl. v., figs. 3-4, p. 111 (1832); Tr., "Die Schmett.," x., 1, p. 129 (1834); Dup., "Hist. Nat.," supp. ii., p. 159 (1835); "Cat. Méth.," p. 42 (1844); Dunc., "Brit. Moths," p. 152 (1836); Evers., "Faun. Volg.-Ural.," p. 111 (1844); H.-Sch., "Sys. Bearb.," ii., p. 86 (1846); Dbldy., "List Brit. Lep.," p. 3 (1847); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Speyer, "Geog. Verb.

Schmett.," i., pp. 320, 461 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," i., p. 146 (1859); Ramb., "Cat. Lép. And.," p. 131 (1866); Cuní y Mart., "Cat. Lep. Barc.," p. 39 (1874); Praun, "Erg.," pl. i., fig. 19 (1874); Frey, "Lep. Schweiz," p. 57 (1880); Meyr., "Handbook," &c., p. 296 (1895). *Lineata* var. *livornica*. Staud., "Cat.," 3rd ed., p. 103 (1901).

ORIGINAL DESCRIPTION *.—Der sieben und dreisigste europäische Abendschmetterling. *Sphinx* alis integ. ano simpl. *livornica*. Der *Celerio* von Livorno.—Alis superioribus, griseis, vitta pallida venis albis: inferioribus rubris nigro fasciatis, segmentis abdominis fusco alboque tesselatis. Er ist Tab. viii., fig. 4, abgebildet, und pag. 87 und 88 beschrieben (Esper *Europ. Schmetterlinge*, &c., ii., p. 196). The description here referred to reads as follows: "On pl. viii., fig. 4, *Sphinx livornica*, a separate species is added for comparison (with *S. celerio)*. In the *Systema*, we are referred to a figure of Petiver's (Petiver, *Gaz.*, Tab. xii., fig. 9, oper. Tom. ii., p. 3): '*Accipitrina livornica, perpelle striata*. From Lisbon, caught flying about a candle in October, 1698. Its eyes, whilst alive, are like rubies. It frequents the jasmin flowers.' The description, which we quote, is too defective to judge from. Nothing further is said than that it had been previously found at Leghorn. The figure which Petiver gives differs considerably from Rösel's. It has not the same wing-contour, it is smaller, the body broader, adorned with series of white spots. Neither the curved lines nor the black spots are shown in Rösel's fig. These were differences enough to excite doubts. Much more nearly in agreement with this figure, I found the moth which is figured, from an original example, at fig. 4 of the present plate. On comparison with this, Petiver's Papilio will be less of a puzzle. We see in both the same traits of contour and markings. The original of this 4th figure on our plate is likewise from Italy. This species has never yet been found in Germany. One of my friends, Herr Pastor Lips, of Petersaurach, obtained it by exchange from an entomologist of Verona. It it peculiar to the warmer parts of Italy, and may thus also, to judge from the similiarity of climate, really occur in Portugal as Petiver says. In the accompanying plate it is, on certain grounds, only noted as a variety of *celerio*, as which it is possible to regard it, but the difference is too considerable to give one grounds for asserting this. I think I shall lighten my readers' labours if I present it for comparison with Rösel's *celerio*, and at the same time point out its similarity to Petiver's figure. It does not admit of being dealt with as a variety, but deserves a separate name. I retain the first, the oldest name, which Petiver gave it, *Sphinx livornica*. I only regret that I am not able to add anything further of its natural history. I have already said all that I can about it. Its difference from Rösel's *celerio* is considerable. The nervures running through the wings are here not black, but white. The whitish-coloured streak which runs through the wings longitudinally is in this, as in that, species, divided by a central black line. It is unicolorous, not so strongly curved, but straighter, broader and more direct than in that species. The hindwings are only pale

* Figured by Esper in 1779 (*Schmett. Eur.*, pl. viii., fig. 4) as a var. of *H. celerio*. Described in 1780 (*loc. cit.*, p 87) by which time Esper had come to the conclusion that it was a distinct species and named it *livornica*. About 1800 (*loc. cit.*, cont., pl. xl., figs. 3-7) he figured it again, in its early stages, after the figures in Fuessly's *Archiv*.

red, not divided by black nervures and spots. Along the body also there are not the connected white lines as in the former species. Here they consist rather of rings of alternately white and brown oblong squares. The figure will enable further comparison" (Esper, *Schmett. Eur.*, ii., pp. 87-88).

IMAGO.—70mm.-75mm. Thorax olive-brown, with 4 white longitudinal lines, the outer passing from the front of head, through base of antennæ to base of hindwings. Abdomen olive-brown, a white median longitudinal line, black and white banded. Anterior wings olive-brown, with moderately wide oblique creamy fascia crossing the forewings from apex to inner margin near base, becoming white at the inner margin; the outer marginal area (slightly purple-) greyish; the nervures raised, creamy-white, but not pale-coloured within the subcostal and outer-marginal areas; a small triangular white discoidal patch contains a minute black dot; innermarginal edge white; fringes creamy, suffused with blackish at ends of nervures. Posterior wings pink, with black base and black submarginal band; outermarginal area pinky-grey, suffused with black scales; a white patch at base of pink median band; fringes white.

SEXUAL DIMORPHISM.—The ♀ appears to be distinctly larger than the ♂, a fact often, however, obscured, as it is much within the limits of individual variation in size. Besides the ordinary difference between the ♂ and ♀ antennæ in Sphinges, that of the male is 1mm. the longer, 13·5mm. and 12·5mm. respectively. The 1st tibia of the ♂ seems slightly longer than that of the ♀. The 1st tibial spurs are almost exactly equal in length in the two sexes, and there is little if any difference in the development of the comb. The ♂ possesses a scent fan at the base of the abdomen, but it is so small and ill-developed that I have been unable to find it without macerating and mounting the specimens. It is a minute wisp of hairs, the longest about 2mm. in length, arising from the external anterior angle of the first ventral plate of the abdomen, its usual site when so restricted. The baton-like scales fringing the segments, so characteristic of all Sphingids, are here, as in other Phryxids, large and in several rows, or at least of varying sizes.

VARIATION.—Oberthür notes that the species varies much in shape and intensity of coloration. Lucas says (*Bull. Soc. Ent. Fr.*, 1880, p. lxviii) that the Tunisian specimens resemble those of southern Europe, except that the colour is richer, and the red of the hindwings clearer, otherwise they are quite comparable with Algerian examples. Bartel says (*Pal. Gross-Schmett.*, ii., p. 100) that the light yellow colour which occupies the middle band varies much in intensity, the enclosed oblique dark band thus being sometimes narrower, at other times broader; it is sometimes dirty yellow-brown. The hindwings also vary much in colour and markings. Bartel further notes that a ♂ from Serach (on the frontiers of North Persia and Turkestan) is very small, only 48mm. in expanse, and altogether of a paler colour than any other specimens examined. A very dark example (especially on the underside), from Sikkim, is in the Kricheldorff coll., Berlin; in this example, the costa of the forewings on the upperside is very broadly dark. In Australia, *P. livornica* occurs as a dwarf form (var. *australasiae*, n. var.), but

is undoubtedly this species, and not *P. lineata*, which occurs in the Hawaiian Islands. The Western Australian examples have also more rounded wings. Kaye states *(in litt.)* that the main variation of this species occurs in the width of the black submarginal band of the hindwing, and the width of the brownish band between this and the outer margin. This is considerable, the Australian specimens having this brownish band quite broad at apex. These latter also have the markings of the abdomen rather reduced, but, perhaps, not much so considering their smaller size.

Phryxus livornica and P. lineata.—Our Palæarctic *Phryxus livornica*, Esp., has, by many authors, been considered as co-specific with the Nearctic *P. lineata*, Fab. (commonly known as *daucus*, Cram.). Not only are the imagines markedly different, but the larva of *P. lineata* is very different from that of *P. livornica*, being the phyletically older (see Weismann, *Studies in Theory of Descent*, pp. 216-217), but, if one compares the larva and pupa of *P. lineata* (Abbot and Smith, *Nat. Hist. Ins. Georgia*, pl. xxxix) with those of *P. livornica* (Hübner, *Sphinges* iii., Legit., B.*c*., figs. 1*a*—*c*), one is convinced, as both are apparently well drawn, that they belong to different species, and one cannot follow Staudinger *(Catalog*, 3rd ed., p. 103) in considering *livornica*, Esp., a variety of *lineata*, Fab. Kirby states *(Ent.*, xxviii., p. 165) that Barrett *(Lep. Brit.*, ii., p. 46) curiously notes *P. lineata* as a variety of *P. livornica*, and then, in the next paragraph, treats the former as a distinct species under the name of *daucus*. The original description of *lineata* reads as follows :—

Sphinx alis virescentibus : fascia striisque albis ; posticis nigris ; fascia rubra. Habitat in America. Statura præcedentis. Caput virescens, stria laterali alba. Thorax virescens, striis tribus albis duplicatis. Abdomen cinereum, albo nigroque maculatum. Alæ anticæ integerrimæ, virescentes, fascia media striisque sex fasciam secantibus abbreviates, albis. Margo posticus cinerascens. Alæ posticæ atræ, fascia media lata rufa; subtus omnes cinerascentes, atomis viridibus (Fabricius, *Syst. Entomologiae*, pp. 541-542). Larva : The mature larva is about 3ins. long and quite variable. The most common form is of a yellowish-green colour with a row of prominent spots along each side, each spot consisting of two curved black lines enclosing a crimson patch above and a pale yellow line below, the whole being connected by a pale yellow stripe edged with black. In some instances these spots are disconnected, and the space between the black crescents is of an uniform cream-colour. The other form of the larva is black with a yellow line along the middle of the back, and a double series of yellow spots and dots along the side. Caudal horn yellowish-orange towards the extremity and rough (Fernald). Pupa : Light brown, the head-case compressed laterally and prominent ; tongue-case not apparent (Clemens). Foodplants : Apple, grape, plum, currant, gooseberry, buckwheat, turnip, water-melon, chickweed, *Rumex obtusifolius*, *Œnothera biennis*, *Portulaca oleracea* (Fernald). Distribution : North and Central America, West Indies, Pacific Islands.

Oberthür and other authors note *(in litt.)* that *lineata*, Fab. *(daucus*, Cram.), from America, is a valid species. It always has six white stripes on the thorax, whilst the European *livornica*, Esp., has always only four such white stripes.

Egglaying.—No note on the egglaying of this species in nature appears to have been published. Eggs, laid in confinement, by ♀ moths captured near Exeter, were light green, and glued to flowers of red valerian which had been placed for the sustenance of the moths. The egg stage lasted about three weeks and twelve young larvæ were obtained (Hellins, *E.M.M.*, vii., p. 102). A ♀ captured at Bromsgrove on May 31st, 1870, laid 15 eggs (Enock).

Ovum.—Apparently undescribed except as above.

Habits of larva.—The larvæ of the summer brood usually emerge from the egg in June and feed up through that month and July, pupating from about the middle of July until August, but Bellier-de-la-Chavignerie notes that he found larvæ feeding on *Rumex acetosella* in June and July at Florac, at the same time that imagines were observed on the wing. The larvæ are more or less polyphagous, and Boisduval observes that they are often found in France by the sides of the roads and in fields, on plants that are not at all nearly allied, and that they are often recorded as feeding on the tender succulent shoots of various kinds of fuchsia, *e.g.*, Gouley took one on fuchsia at the beginning of July, 1866, at Calvados, the example pupating and the imago emerging on October 3rd, whilst Lucas found some on fuchsia in the gardens of the Parisian suburbs, in 1856, &c. Godart records larvæ captured, in the latter year, on *Galium verum*, at St. Cloud, whilst Allard remarks that they are not rare on *Euphorbiaceae* at Biskra, where they are larger and brighter than those taken in mid-France. Rambur notes (*Cat. Lép. Andal.*, p. 131) the larvæ as being almost polyphagous and sometimes so abundant in the plains of Malaga, along the fields, that one may collect some hundreds in a short time. Chaumette records the larva on vine on June 19th, 1846, on Les Mousquines, near Lausanne. In Sicily the larvæ are said to feed almost entirely on vine, and Millière observes that those of the first brood are fullfed at the end of June, and, as the pupal stage lasts only about a fortnight, the imagines emerge about the middle of July. Very few larvæ have been recorded as taken in the British Islands. A few were taken in 1870, of which one, captured near Exeter on July 11th, was recorded as a larva of *Celerio gallii* (*E.M.M.*, vii., p. 61), and which spun up and produced an imago on August 18th (Hellins). On July 4th, 1870, three larvæ were taken on vine near Ryde, and four more on 26th on vine and garden centaury ; the largest of these last spun on the 27th and changed to pupa on the 30th, a fine imago appearing on August 26th (Farn) ; a larva found near Saltash in a mangold-wurzel field, fed on broad-leaved plantain, was fullfed on July 12th, and an imago emerged August 11th, 1870 (Hobbs) ; nine larvæ taken on dock in a nursery at Plymouth in 1870, all gave imagines the same season (Rickard *teste* Purdue), another was found on July 29th, 1870, in a garden at Plymouth (Bignell); five larvæ were found at Sketty Park in August, 1892, feeding on vine, and pupated well, when the box containing them was lost (Robertson) ; a fullfed larva was found on July 22nd at Starcross, which pupated, and produced an imago on September 27th, 1902 (Jäger).

Larva*.—The *young larvae* are at first of a dirty-white colour, without any spots, but with the head and horn black ; at the end of the second week they begin to assume markings, and, when about $1\frac{1}{2}$ins. long, the head, back, horn, belly and legs are all intensely black, but the segmental folds show paler so as to give the appearance of alternate lighter and darker bands, the subdorsal line is red, as well as the subspiracular ; the sides are dotted with yellow ; the subdorsal

* No useful description of the very early larval stages appears to be available. We know of none in the literature to which we have access.

spots seemed to have made their appearance by this time and were red in colour (*E.M.M.*, vii., p. 102). Fuessly figures (*Archiv*, i., pl. iv., figs. 1-4) a larva, pupa and imago of *P. livornica*—the imago from a moth taken by Kœchlin at Mulhouse (in 1773 or 4?) and the larva from one taken at the same place by Spœrlin, who sent a figure by Kœchlin to Fuessly on July 19th, 1780. This larva fed on *Galium*; the figure is one of the ordinary form so often figured of the larva of *P. livornica*, with a pink dorsal line, and rows of pink subdorsal and of postspiracular ring-spots. His further record (*Archiv*, vi., pl. xxxiii), meagre as it is, is noteworthy as almost the only record of the larva of this species, except in its last instar. On this plate he figures a larva in its last, its penultimate, and ante-penultimate skin, and, like another larva that he records, and which precisely resembled his larva of pl. iv, this one fed on vine. It is remarkable as being a very marked variation from the type form, and does not appear to be elsewhere figured. He says that it produced the same kind of moth as the others, and there is no other species that it could possibly be of those known to occur in Europe. This larva has, in its last instar, a broad, black, dorsal band, somewhat wider than the ordinary pink one, and so shortening the black offsets (that occur on ordinary larvæ) towards the subdorsal pink ocellated spots. These ocellated spots are of the same colour as the subdorsal line (yellowish), outlined with a narrow black line, without which they would simply be parts of the subdorsal line, which is unusually broad. These ocellated spots are not, as in the normal form, round, but the black marks above them take out their upper portion, making them lunate with the cusps upwards. The yellow subspiracular line is also very broad, and the pink postspiracular ocellus is shown divided into two portions, and is more brick-red than pink. The under portion of the larva is very dark, instead of pale flesh colour. It is, of course, very probable that the younger larva also differs from that of the type at similar ages. His account of this larva is that it was found in the middle of July, 1784, by Mr. Schellenberg in a vineyard near Winterthur. It fed well on vine leaves, which it devoured greedily. On the third day it changed its skin and had another moult 8 days later. The red spots, which had disappeared at the preceding moult, reappeared. It continued to feed as before and grew so rapidly that, in 8 days, it was fullgrown and, two days later, got restless, ran about the box, and finally made a cocoon amongst leaf-rubbish. It changed to pupa in less than four days. Scarcely three weeks later *S. koechlini* emerged. Fuessly could see no difference between this and the Mulhouse specimens and others from Italy. The figures show the youngest larva 41mm. long, with a yellow dorsal line, head and last segments red. The other markings and coloration the same as usually figured in the last instar. The second figure, in penultimate skin, is 51mm. long, and, except that the base of the horn is pink, the colours are entirely yellow and black, and the markings, as already noted above, as in the fullgrown larva. The latter is drawn as 100mm. in length, stretched out (Chapman). The *fullgrown larva* is described by several entomologists: (1) About 3½ins. when stretched; the head is the smallest segment, the body tapering towards it from the fifth segment; the anal prolegs broad and square; the horn slightly curved, blunt at the tip, and rough; the skin rather shining,

but, on the hinder half of each segment, showing seven folds, well defined at the sides, but not so distinct on the back, where the skin seems tighter. The ground colour of the back and sides, as far as the spiracles, is an intensely dark green ; the head black, but with a streak across the mouth, as well as the base of the papillæ, lemon-yellow ; the plate on the second segment black ; an ochreous-yellow dorsal stripe commences on the third segment and is continued to the horn, it is suffused with rose-pink, and is bordered for some little width on each side by the plain ground colour. A sort of transverse band, also of the ground colour, is placed on the front of each segment, extending from the dorsal line to below the subdorsal; the rest of the sides is irrorated with small greenish-yellow spots which become more whitish near the spiracles. On the lower ends of the above-mentioned bands on segments 4 to 12, and just in the region of the well-defined, greenish-yellow, freckled, subdorsal line (in fact, strung on it like beads on a string), is a row of nine, large, roundish, lemon-yellow spots, tinged, in the upper part, with pink ; these are made all the more conspicuous from being delicately bordered with black, and have also two largish spots of black on their upper border. On segment 3 there is no spot, but only the subdorsal line. The spiracles are ochreous-yellow, tinged with pink ; just below them is an inflated and puckered stripe, yellow on the second segment but whitish on all the rest, and interrupted just behind the middle of each segment by a large round spot of pink, slightly tinged with olive ; the belly also pinkish ; the anterior legs black ; the ventral prolegs pinkish-white, tipped in front with a spot of black ; the anal prolegs black, a pink edge at the side of the anal flap. I have called the subdorsal spots roundish, but, in reality, the shape is somewhat that of a dumpy pear with the short stem pointing forwards and upwards, whilst the last spot in the row, that on segment 12, may be described as of an elongated pear-shape, with the point directed backwards and upwards towards the horn (Hellins). (2) The head and second segment and the anal prolegs all deep pink ; the dorsal line yellow ; the horn red and rough ; the ground colour dark green, freckled with yellow, save in the transverse bands on the front of each segment ; the subdorsal line yellow, but without the row of roundish spots ; the belly yellowish (Marshall, *Buckler's Larvae*, ii., p. 44). (3) The head and the second segment black, an intensely black stripe all down the back, the transverse bands black, and enclosing at their extremities semilunar spots of yellowish-white on the subdorsal line, the pinkish suffusion of the round spots in this case replaced by black, and so the usual outline of the spots is altered ; the rest of the back and sides blackish, irrorated with greenish-drab ; the belly also very dark, the horn dark purplish (Gatcombe, *loc. cit.*). (4) The larva is about $3\frac{1}{2}$ins. in length, smooth and black, but so covered with yellow dots as to appear nearly yellow ; the head dull pink ; the upper part of the 2nd segment has a semicircular, plate-like appearance of the same colour ; the dorsal line yellow ; each segment blotched with dull red and bordered with black ; the black on the front part of the segments, from the 4th to the 11th, expands into a would-be square spot, but for a series of eight yellow semicircular spots resting on the subdorsal line, the centres

of which are pale pink; subdorsal line yellow; spiracles yellow, with a pink blotch behind and below them; the belly, claspers, and prolegs whitish-yellow, the lower extremities of the prolegs black; a large black oval spot on the front part of all the claspers; the upper part of the anal claspers and flap are of the same colour as the head; the caudal horn straight and very rough, red, tipped with black (Bignell, *Ent.*, v., p. 169). (5) The head and body soot-black; in one a dorsal line of reddish-brown, in another no dorsal line at all; the subdorsal line yellow, uninterrupted; slightly below these and between each segment a dull reddish blotch; the belly and claspers ochreous, speckled with black. Three other larvæ differed from those described above in that the subdorsal lines were indicated by yellow ocelli (Farn, *loc. cit.*, p. 180). (6) Length about 3·25ins.; head black; caudal horn red and pink; a black line runs the entire length of the back, about $\frac{3}{16}$in. in width, with transverse bars on each segment, extending about $\frac{3}{16}$in., and near the same in breadth, at the end of which is a cluster of minute white dots in the form of a crescent; a narrow black line divides each segment; on the sides are a great number of minute yellowish dots dispersed in rows; on the lower side, just above the legs, runs a distinct line of small dots with a series of small crescents below; the sides have a yellowish-green appearance; the belly is rusty black (Hobbs, *loc. cit.*, p. 214). (7) Smooth, elongated anteriorly; ground-colour apple-green, more or less speckled with yellowish; an olive-coloured dorsal line dilated into a triangle on the 1st segment; the lower half of the body, and all the abdomen, of an uniform yellow-olive colour; a series of large oval patches of shining light yellow on either side of the dorsal line, two on each segment, of which those of the middle segments are the largest, brightest and roundest; each of these patches is encircled with black; a brownish interrupted lateral line on which are placed the stigmata; abdomen yellowish-olive, with a darker ventral line; all the prolegs are of the same colour as the abdomen, the thoracic legs tipped with shining brown; head greenish-olive, with a triangular brownish patch over the mandibles; the mandibles and lower part of the head black; caudal horn of a yellowish-green colour, granulated and tipped with black; a pale lateral line between the dorsal and lower line (Chaumette, *Zool.*, ix., p. 3160).

Variation of larva.—We have already quoted the descriptions of several different forms of the adult larva of this species *(suprà)*, as well as that of Fuessly's quite unusual variety. That described by Marshall appears to be the palest, whilst intermediate between it and Hellins' Exeter larva is that described by Bignell. On the other hand, that described by Gatcombe was much darker, and must have come near to Fuessly's figure referred to above and used by Stainton in his description in the *Manual*. Bartel observes *(Pal. Gross-Schmett.*, ii., pp. 98-99) that the larva is, when full grown, 80mm.-90mm. in length, and agrees in size and form with those of *Celerio gallii* and *Hyles euphorbiae*, and that there are two different forms: (1) Light green, thickly dusted with yellow; on each segment a quadrate black spot, and, beside it, a rose-red one margined below with white; below these spots runs a yellow lateral line; above the legs appears on each segment a round red spot. Belly and

legs yellow-grey. Head dark rose-red. Of the latter colour is also the rather strongly-expressed dorsal line. The caudal horn is black beneath, and only red above. Spiracles whitish or yellowish, black-margined. (2) An aberration, sometimes occurring locally, has a broad black dorsal line, which extends laterally on each segment as far as a round, white or yellow, black-margined spot. This touches a light double lateral line, whose lower part is rose-red spotted on each segment. The belly, legs and head are black, the horn red beneath, black above. Allard observes (*Ann. Soc. Ent. Fr.*, 1867, p. 315) that the larvæ found at Biskra (feeding on Euphorbiaceous plants) differ somewhat from those seen in mid-France, being larger and brighter, and Oberthür also notes (*in litt.*) that the larvæ at Biskra offer a very pretty melanic form, of which he has several examples in his collection. Boisduval speaks of the larva as "cette belle chenille, qui varie beaucoup," and suggests that, in all its variations, the distinctive mark is the subdorsal pale line, generally bearing on it the row of pale spots. He figures (1) A larva, with deep red head, prothorax, dorsal line, caudal horn and anal prolegs, and says that the ground-colour is "noirâtre ou d'un brun roussâtre," the transverse bands black, the subdorsal line and row of spots pale yellow, the sides irrorated with yellow dots, the venter pinkish, the horn slightly curved. (2) A larva of pale green * hue, with lilac dorsal stripe, a subdorsal row of whitish spots suffused with pink, placed on a whitish line, the sides irrorated with white spots, a pinkish subspiracular line, and a brown straight horn.

Development of larval markings.—The larva of this species possesses almost the same markings as that of *Celerio gallii* in its 4th stage, *i.e.*, a subdorsal line with interpolated ring-spots; all examples examined agree in having the ring-spots sharply distinct from the whitish subdorsal line, so that the latter is thereby interrupted. Figures of the adult larva are given in the works of Hübner, Boisduval and Duponchel. In most specimens the ground colour is brown, although Boisduval also figures a light green specimen, from which it may be inferred, from analogy with *C. gallii* and *Thaumas vespertilio*, that the first stages are green. A young larva (in coll. Staudinger), probably in *4th stage*, has the ground colour light ashy-grey; the dorsal and subdorsal lines are white, the latter showing, in the positions where the ring-spots subsequently appear, small white "mirrors" with red nuclei, exactly corresponding to the stage of *T. vespertilio*, represented in pl. vi., fig. 49*a*. The "mirrors" are nothing more than dilations of the subdorsal line, which is not, therefore, interrupted by them. The black "ground area" does not surround the "mirrors" completely, but borders them only above and below, and is much more strongly developed above, extending in this direction to the dorsal line. . . . The adult larva of the American *P. lineata*, Fab., differs from that of *P. livornica* in remaining permanently at the 4th stage of the last-named species. The ground colour of the larva is green, the subdorsal band yellow, bordered with black, slightly curved, arched lines, which nowhere interrupt its continuity, so that the North American species appears

* Hellins believes this to have been figured from a blown larva, and considers that this would account for the pale colour and the shape of the horn.

to be an older form than our *P. livornica* (Weismann, *Studies in the Theory of Descent*, pp. 215-217).

COCOON.—The cocoon is made on the surface of the earth, slight, formed of a few bits of earth and withered fuchsia flowers just tacked together with a few silken threads, many interstices being left through which the pupa can be seen (Buckler). The transformation takes place among spun-together leaves, scarcely below ground (Bartel). The puparium of one that spun up in the leaves at the bottom of a box on July 27th, 1870, was made of so fragile a web that the larva rolled out before finally changing to a pupa on the 30th; another spun up under some moss in the breeding-cage (Farn).

PUPA.—The pupa belongs much more to the "*alecto* group" than to the "*euphorbiae* group." Viewed dorsally it narrows forwards from the middle of the prothorax, and viewed laterally it is seen that the maxillæ extend not only round to the front of the pupa, as in *Hyles euphorbiae*, but right away dorsally, so that the labrum is situated dorsally 2·6mm. further back than the extreme front of the pupa, which is formed by the maxillæ. The centre of curvature of the glazed eye is directed halfway between anteriorly and dorsally, *i.e.*, it is rotated 135° from the ventral aspect it has in most pupæ. In this pupa, the impression that the anterior projection formed by the maxillæ conveys of being a very similar structure to the beak of a Chinese lantern fly *(Fulgora lanternaria)* is especially given, as it is, to a great degree, in many similar Eumorphid (Chœrocampid) pupæ. This pupa is 49mm. long, with the Chœrocampid curve well marked. The dorsal line is prominent at the mesothorax and 5th abdominal, the ventral at 3rd to 4th abdominal, and the tapering at extremities is more marked dorsally than ventrally. The pupa is, except at the head, somewhat flattened, that is, its transverse diameter is always greater than its antero-posterior. This, together with the general outline of the pupa, may be derived from the following measurements:

MEASUREMENTS AT	DISTANCE FROM FRONT OF PUPA AT	TRANSVERSE DIAMETER AT	ANTERO-POSTERIOR DIAMETER AT
Labrum, all in front of this is maxillæ ..	3·0mm.	4·0mm.	6·0mm.
Origin of antenna and posterior angle of glazed eye	7·0 ,,	5·5 ,,	7·5 ,,
Front of prothorax	8·0 ,,	6·6 ,,	8·0 ,,
Prominence of end of 1st tibia	10·0 ,,	9·2 ,,	
Prominence of mesothorax	12·0 ,,	10·0 ,,	9·0 ,,
End of 1st leg	18·0 ,,		
End of antenna	20·0 ,,		
Prominence of appendages ventrally.. ..	24·0 ,,	12·0 ,,	10·5 ,,
End of 2nd leg	28·0 ,,		
Prominence of 4th abdominal segment ..	30·0 ,,	12·0 ,,	10·0 ,,
End of maxillæ and wing	(32·5), 33·0 ,,		
Prominence of 5th abdominal segment ..	35·0 ,,	11·0 ,,	9·0 ,,
7th abdominal segment	41·0 ,,	9·0 ,,	7·0 ,,
Base of anal spike	47·0 ,,	2·0 ,,	1·1 ,,
End of pupa	49·0 ,,		

The prominence of the maxillæ has rough transverse ridges,

it is very wide opposite the glazed eye where the usual outer angle forms a right angle, and here measuring 4·0mm. across, it narrows in the next 6·0mm. to 1·0mm. The other mouth-parts are represented by a transverse ridge across the dorsum, which rises at each end into definite little knobs, which seem to be rather an angle of the epicranium than the mandible. The end of the first tibia rises into a strong prominence, just opposite the appearance of the 1st femur, between the 1st leg and maxillæ, this is rather a widening of the suture here for about 3·0mm. than an actual appearance of the femur. All these appendages are marked by fine but rough transverse ridges. The posterior margins of the wings are hollowed out so as to form a curve, and make the anal angle somewhat acute and the inner veins (1*b*?) curved to an even greater extent, since it reaches the anal angle, but recedes just above, 7 further veins are quite prominent, the 7th reaching the apex. The head and thoracic segments are sculptured in raised ridges or wrinkles, more or less broken up into islets, but except these minute nodules on the head, presenting no special development. The first spiracle is raised, both lips rising above the general surface, especially the posterior one. The metathorax falls in laterally more than dorsally, and forms a definite waist. The sculpturing of the 1st and 2nd abdominal segments, and even of the 3rd, is of a doubtful intermediate character, but, on the 4th and following, it consists definitely of a number of fine circular pits. These are, however, in some degree, in transverse lines, and, in the posterior portion of the segments, spread a little laterally, so that one sees a continuity between the plateau with pits of the front of the segments, and the irregular interrupted ridges with valleys between of the thoracic segments. On the 4th segment, in front of the spiracle, is a specially rough area, with many sharp ridges and anastomosing valleys between, which fade out in each direction into the ordinary pitted structure. The spiracles are a little darker than the surface around, each is an oval hollow with a narrow axial slit. The anal spike, 2mm. long, 2mm. broad and 1mm. thick, is dorsally continuous with the general surface, but ventrally is cut off from the anal region proper by a transverse groove; it has a faint longitudinal ventral groove, is basally faintly rough, terminally rather polished, the extremity is not very sharp. The anal prominence has a longitudinal groove, and, on either side of it, is a very distinct small round eminence. The ventral centre of the 9th segment presents two small rounded eminences. The prolegs are represented by slight depressions, with fine wrinkles, radiating from a nearly smooth centre. The hindwing extends down to the spiracle of the 3rd abdominal segment as a narrow strip, indented by the spiracles of the 2nd abdominal segment, and with no structure shown, except the ordinary transverse fine ridges (Chapman. Description made from a not very good ♂ pupa supplied by Mr. Head). The pupa measures 47mm. in length and about 37mm. in greatest girth. It is stout across the wingcases, which are long; hence the widest part of the pupa is slightly beyond the middle of its length, *i.e.*, nearer the posterior extremity. It then tapers off rapidly in both directions. The anal extremity terminates in two small, rounded, lateral projections and a short, narrow,

sharp dorsal spike. The very peculiarly-shaped narrow headpiece is terminated by a helmet-like projection, apparently containing the mouth-organs. The surface is fairly smooth, but not shining; it is, in fact, very slightly shagreened. In colour the pupa closely resembles that of *Hyles euphorbiae* (Lucas). Long, of a light brown colour, the last two segments darker brown, the anal spike strong and sharply pointed, but with no other projection to break the outline (Buckler). Yellow-brown, similar to that of *H. euphorbiae* (Ochsenheimer).

Foodplants.—Almost polyphagous (Boisduval), dock (Cumming), knot-grass (Bignell), vine, fuchsia, ? marigold, ? grass (Hellins), *Vitis vinifera*, *Galium verum*, *Beta*, *Scabiosa* (Bartel), garden centaury (Farn), broadleaved plantain (Hobbs), *Sonchus arvensis* (*teste* Duncan), *Erythraea maritima* (Mabille), *Galium mollugo* (Chaumette), *Rumex acetosella*, toadflax (Bellier-de-la-Chavignerie), *Euphorbiaceae** (Allard, *Ann. Soc. Ent. Fr.*, 1867, p. 315).

Habits.—This species occurs more or less abundantly at irregular intervals in Britain, although two or three consecutive years rarely pass without some examples being captured. It has apparently a permanent home on the southern littoral of the Mediterranean, abounding in certain parts of northern Africa, where it is also continuously-brooded, and whence it gives off numerous emigrants, which spread into southern, central, and northern Europe. The spring brood is generally the migrating one, the May-June immigrants laying eggs which give rise to native-born imagines in August-September, or even later in the countries they visit, although, in some years, *e.g.*, 1869, the spring arrivals are apparently not able to lay the foundation of an autumnal brood. As to actual evidence of its migration, Fletcher records (*Ent.*, xxxiv., p. 223) that, on May 1st, 1901, when about 100 miles from Greece, two specimens of *P. livornica* were caught on board ship, which had possibly flown on board the night before, although all lights were out, and suggests that it is quite possible that they were migrating. Manger has a specimen that flew on board ship in the Red Sea, and Boisduval notes (*Hist. Nat.*, p. 173) that Daube did not consider it indigenous to southern France, but that the French examples came from the north of Africa or southern Spain; he asserted that he had seen every year, in full daylight, a large number cross the Mediterranean Sea. A note to the effect that the imagines were especially abundant at Montpellier after violent south winds, in May, 1834, is also published (*Ann. Soc. Ent. Fr.*, v., p. 363). An example was taken in a boat on June 18th, 1863, at Modbury, in Devon (Green), and Stephens notes a specimen taken in June, 1824, at Billingsgate, off a Ramsgate steam-vessel, and one, recorded as *Hyles euphorbiae* (*Ent. Wk. Int.*, v., p. 11), was picked up on the beach at Chickerell (Payne), whilst, on May 26th, 1870, one was captured on the shore at Folkestone; this specimen was observed flying out at sea, and it dropped directly it reached the shore (Knaggs). In the British Isles and in central and southern Europe generally, it usually flies at dusk, being attracted by numberless flowers, although, in northern Africa, the Cape of Good Hope, the Levant, Spain, and the warmer parts of what may

* Eversmann records (*Bull. Ent. Soc. Mosc.*, x., 1, p. 30) that *P. livornica* flies commonly at the end of May among *Euphorbia* with *Hyles euphorbiae* on the steppes on the Achtuba, although he does not say that the larva feeds thereon.

be called its native territory, it flies freely to flowers by day in the most brilliant sunshine. Thus Blackmore notes its great abundance in February and March, 1868, at Tangier, where it affected most the flowers of the various kinds of lupin with which the hills are clothed; it was equally abundant in the early spring of 1870 in northwest Morocco, and one suspects that this early abundant February to April brood provides us with our spring immigrants. Swinton observes that, on the sandhills at Jaffa, which resemble the well-known hunting-grounds at Deal as regards fauna and landscape, this moth was common in April, 1896, darting from the stunted vinestocks before the advancing footsteps with a swiftness that literally rendered it invisible. Ménétriés found a specimen at 12000ft. elevation in the snow region of Mt. Elburz. Oberthür says that he has seen it at the summit of the Canigou at an altitude of 2785 mètres, and has observed it in the Pyrenees flying throughout the day at flowers in August. Guenée also says that he has seen the species flying at great altitudes in the hot sun, whilst, in the plains, it appeared to fly in the evening. Oberthür, however, insists that it flies by day in the plains as well as in the mountains. Allard observes that, at Biskra, the moth flies among Euphorbiaceous plants, and Eversmann, as we have noted, makes a similar observation, stating that *P. livornica* flies with *Hyles euphorbiae* among *Euphorbia* on the steppes on the Achtuba. Chapman records that, at Tragacete, about July 20th, 1902, three specimens of *P. livornica* were taken flying in the forenoon—two were taken one day and one the next day, about 10 a.m., and at precisely the same spot. None were supposed to be seen elsewhere; they were 2 ♂s, 1 ♀. Merrifield states that he started one up, at about 1 p.m., in a heathy field near Cuckfield, and there are other records of its day-flying habits, *e.g.*, Brown notes (*Mag. Nat. Hist.*, viii., p. 556) that he was surprised at finding it at noonday on *Cirsium eriophorum* on the alp of Sollalex, at the foot of the Diablerets. Caradja says that, in Roumania, the imagines fly by day even in cloudy weather, and Bartel notes (*Pal. Gross-Schmett.*, ii., p. 99) that, when the sky is clouded, the moth is sometimes met with by day. He further points out that it is particularly partial to strongly-scented flowers at dusk, and notes that it especially favours *Saponaria*, *Silene maritima*, *Valeriana*, *Cirsium eriophorum*, *Rhododendron*, *Phlox* and *Petunia*. The following records may be interesting. Common in the gardens at Collo at flowers of petunias in the evening (Seriziat), common some summers at Tangier and Gibraltar at flowers of *Plumbago capensis*, *Pelargonium*, &c., also found at rest on walls (Walker), a specimen seen flying at flowers in the hot sun at Weissenburg (Huguenin), several captured flying at flowers in the bright sunshine on both sides of the Sea of Marmora—European and Asiatic—from May to August in 1878 (Mathew), a very fine example flying over flowers in daytime captured in woods at Polegate (Ward), and one flying over a chalk bank near Walmer Castle (Leslie), a ♀ at flowers of *Silene maritima* at Douglas Head (Crennel), at dusk at flowers of *S. maritima* and red valerian at Torquay (Jones), at red valerian at Croydon (Gower), six imagines in 1870 at petunias and verbenas near Plymouth (Purdue), at flowers of pelargonium in greenhouse at Abingdon (Walker), at rhododendrons in Jersey

(Johnson), five at flowers of the same plant at Wishanger (Bingham-Newland), also at Knutsford (Sidebotham), at Horrabridge (Still), at Swansea (Robertson), at Osmeau Park (Watts), at Dorking (Flood), and several at Mount Edgcumbe (Sturt); at verbenas in middle of day, continued at flowers for four or five minutes until captured, at Saltburn-on-Sea (I'Anson), at sunset at flowers of yellow azalea at Tiverton (Pole), at lilac blossom in the evening at Haslemere (Chandler); at verbenas at 8.30 p.m. at Egg Buckland (Briggs), and about 8 p.m. at Kilkea Castle (Douglas); at pinks at Wolstanton (Heale), at dusk at scarlet geraniums at Torquay (Grinstead), and at the same flowers at twilight at Newport (Moberly), and at Glanvilles Wootton (Dale); at red campion and valerian at Dartmouth (Coles), at Marvel of Peru flowers and white verbenas at Exeter (Hellins), at pinks at Wolstanton (Daltry), at geraniums at Darlington (Backhouse), at the same flowers on damp showery evenings shortly after dusk at Niton (Clarke), at scarlet geraniums just before daybreak (Bloomfield); three at blossoms of lousewort at Bloxworth (Cambridge), at *Silene pendula-compacta* about 9 p.m. (Hyde), at petunias at Killarney (Birchall), at lilies of the valley at Ennis (Brakey), flowers of white narcissus at Torquay (Stewart), at jessamine at Portsmouth (Larcom), flowers of convolvulus at Reading (Poulton), flying in evening over flowers at Florac (Bellier de la Chavignerie). Other examples have been taken at rest—one on trunk of apple-tree, and another on trunk of pear-tree, at Bournemouth (McRae), resting on bramble at Box Hill (Paskell), one on a truss of straw near Lindfield (Blaber), in a garden at Torquay (Jones), and at Winchester (Nevinson), and at Lyndhurst (Ward-Jackson), a large ♀ on a bank of irises at Preston, Brighton (Morris), on a furze-bush at Lymington (Patterson), on a bank at Langharne (Kaye), a ♀ on a vine-leaf at Birmingham (Enock), in a greenhouse at Kilkenny (Bristow), in a chalk-pit near Lewes (Blaker), on front of house at Hawick (Guthrie), on a piece of granite at Sandwich (Harbour), on a grass lawn at Lewisham (Stainton). Few examples have been taken at light—Oberthür states that a specimen was captured at the electric lamp on the Riffel Alp at the end of July, 1902; Fletcher notes this species at light, on July 20th, 1898, on board ship at Wei-Hai-Wei; Frohawk records an example at the light-house lantern of St. Agnes, Scilly, just before sunrise, also one on an electric lamp at Carrow, near Norwich (Laddiman), on a gas-lamp at Dover (Eedle), at light at Limpsfield (Patterson), flew into a room to light at Hunton, near Maidstone (Greville), three round a lamp at Worcester (Edmunds), flew into a room at Coles Cross (Helps), at light at Ventnor (Keet), at Wolverhampton (Morris), at Merthyr Mawr (Hampson), flew into a room at Mullaghmore (Greene). The irregularity in the appearance of this species in Europe is proverbial. Even in Spain it varies much according to the season, being sometimes rare, and at others very abundant, *e.g.*, at Bilbao (Seebold); it was unusually plentiful near Berne in 1818 (Brown), and swarmed throughout Switzerland in the miserable summer of 1883 (Frey), in which year also it was in great numbers from July 7th-August 12th at Rohrerberg; it was abundant, too, in June of that year in Thuringia, and in July of the same year in Baden, whilst it occurred almost continuously the whole of the year 1846 at Freiburg; the spring specimens are always rare in Bucovina, but in certain years,

e.g., 1882, 1892, the autumnal brood occurs in great numbers (Hormuzaki); exceedingly abundant in Roumania from 1889-1892, but not seen in 1893 (Caradja). It was also reported as especially common at Collo in 1874 (Seriziat). In Britain the years of abundance have been 1846, 1860, 1868, 1870.

TIME OF APPEARANCE.—It is difficult to state exactly the number of broods that this species has in those countries in which it is sedentary, but the fact that pupæ obtained here in autumn emerge in a few weeks or die, suggests a continuously-brooded habit in the parents. Rössler also observes (*Die Schuppenflügler*, no. 119) that the species is not indigenous in Germany, that it occurs occasionally in abundance and produces larvæ and pupæ, but that the winter always destroys the latter. It abounds in February and March in some years at Tangier and Morocco (Blackmore), again from June 15th—July 15th at Collo (Seriziat), and Gouley records breeding an imago on October 3rd, 1866, from a July larva at Calvados. It is remarkable that, in Britain, in 1858, 1860, 1862, 1867, 1879, 1888, 1892, and 1893, only spring and very early summer specimens occurred, without giving rise to an autumnal brood, whilst, in 1865, only an autumnal appearance is recorded; this also was the case in 1868, with the exception of a single early capture. In 1870, the normal spring appearance was followed by a normal autumnal one, and several larvæ were obtained, and we are thus convinced that, in Britain, the immigrating May and June imagines may produce another brood in August-September (or even later). Walker notes it as occurring in August at Gibraltar, whilst our dates give considerable evidence that late-feeding larvæ that pupate and are satisfactorily protected must emerge after a short pupal period *, and we would call especial attention to the facts that Blaker records (*Ent. Wk. Int.*, ix., p. 146) one caught in a chalk-pit, near Lewes, on January 28th, 1861; Burt writes (*loc. cit.*, p. 155) of one captured February 2nd, 1861, at Torquay; whilst Helps notes (*Proc. Sth. Lond. Ent. Soc.*, 1887, pp. 23, 53) one that flew into a cottage, possibly attracted by light, at Coles Cross, near Crewkerne, at the commencement of February, 1887 †. The species was captured April 24th, 1902, at Aranci Bay in Sardinia, May 1st, 1901, at Patras, and May 7th, 1901, at Malta (Fletcher); in Syria, the larvæ are to be obtained in May, the imagines appearing in from 5-6 weeks (Lederer), and we surmise

* We have no doubt that Morris' record (*Ent.*, v., p. 96) that he "bred two imagines on July 18th, 1867, from larvæ obtained near Wolverhampton on *Populus alba* the previous year, the pupæ having gone over with those of *Amorpha populi*," &c., is quite erroneous. The remark of the Editors of the *Ent. Mo. Mag.*, 1870 (vol. vii., p. 40), to the effect that all spring specimens caught here have hybernated, is very peculiar, as there is not a shred of evidence that this species hybernates in the imaginal state in this or any other country.

† It is remarkable that, in spite of all the captures recorded in May, 1860, there was no autumnal record, although one suspects that there must have been such, and that these two early 1861 emergences were the progeny of autumnal parents. At any rate, it would appear that these must be either the result of the May-June, 1860, examples, from larvæ that had taken a long time to feed up, or of an unrecorded autumnal 1860 brood, or an abortive winter immigration which is scarcely probable. It is further to be noted that these were the only 1861 records. It is still more remarkable that the Coles Cross example was captured, in 1887, after the species had been unrecorded in Britain for 2 years, and was, similarly, the only record of the year. On the whole, the evidence tends to suggest that, except in such a year as 1870, most of the captures, spring and autumnal, are actual immigrants and not home-bred from immigrating parents.

that these May larvæ come from April imagines, for Swinton records them as abundant at Jaffa, &c., in April, 1896; Fletcher observed the species again on June 30th, 1902, at Cyprus, and Mathew almost continuously from May to August, 1878, on both the European and Asiatic coasts of the Sea of Marmora. Romanoff notes it as occurring at the end of April and again in August in Transcaucasia. April is given as the time of appearance in northern Persia and Tunis, where, however, no record is made of the later broods; near Cape Town it is recorded as flying by day, often settling on a species of *Echium* in December, 1863 (Trimen), and it was taken at Eyk, in North Central Somaliland, on July 3rd, 1897 (Peet). In most of the European countries, May-June and August-September are given as the chief times of appearance, the former being, as with us, the time of appearance of the immigrants, the latter, probably, the time of appearance of their progeny. In Sicily, there is a May appearance, another mid-July emergence, and one suspects a September appearance, whilst May-June is noticed for the Roman Campagna, with no record of a second appearance, May-July and September in Baden, May and September in Hungary, May-June and again in July-August at Budapest (*teste* Bartel), June 4th, 1900, at Pöstlingberg (Himsl), May-June and August-September in the Haute-Garonne (Caradja), whilst the end of May alone is given for Sarepta and north-west Asia Minor, where later broods are almost sure to occur. June and July are noted as the main months for Lombardy, Tuscany, &c., and at Boscolungo it is sometimes very common (Caradja), but one suspects at least one earlier, and one later, appearance. An example was captured on June 18th, 1890, in Turkestan, and July is given for Quetta. Caradja notes the two autumnal broods, in August and October, in Roumania, where, at least, in the northern parts, the species is not a permanent resident, but only an accidental visitor. Hudák notes May 20th, 1880, July 20th, 1884, and September 12th, 1885, as dates of capture at Gölnitz, whilst Fritsch gives June 17th, August 6th, August 27th and September 4th at Salzburg. In Britain, where the species only occurs irregularly as an immigrant, many imagines are, in its years, taken in April, May or June. The eggs laid by these sometimes produce imagines again in August or September. Larvæ and pupæ from these latter either have to come to maturity in early winter or are killed off, the conditions of our winter climate being presumably unsuitable for their successful hybernation. The species is probably not really indigenous in Europe, except in a very few favoured spots on the Mediterranean littoral. Throughout almost all Europe years of comparative abundance are often followed by years of complete absence, and the species occurs singly in most parts of Europe only as a vagrant from its subtropical haunts. The following are the dates of the recorded British captures: In 1823 at Sunderland (Backhouse); in 1824 at Billingsgate on a Ramsgate steam vessel, in 1827 at Bethnal Green, in 1829 at Hull (*teste* Stephens), April 19th, 1829, at Wakering (Dale), May 20th, 1830, at Castle Martyr (Law); July 5th, 1834, three ♀s near Peterborough, one of which laid eggs which hatched in due course, another about the same time near Worcester (Dale, *Maund's Nat.*, i., p. 13); June 25th, 1844, a ♀ at Chorlton, a ♂ a few days later (Edleston), June, 1844, at Winford (Bromfield); one in mid-April, 1846,

at Penzance, another at Pendarvis (Noye), one in Bethnal Green churchyard (Bramley), one each on April 16th and May 1st, 1846, at Hammersmith (Stevens), one on April 18th, at Langport, another, at Bristol, on April 20th (Dale *teste* Stevens), also two in April, 1846, at Cork (Clear), one in April, 1846, at Ventnor (Bromfield), two in June, 1846, at Lewes (Weir), in 1847, at Preston and Carlisle (Cooper), in 1848, at Horley (Gregson), in 1856, at Newtown Hill, Tramore (Burkitt *teste* Wallace), three in the autumn of 1857, at Worcester (Edmunds), April 20th, 1858, at Alphington (D'Orville), May 12th and 15th, 1858, at Brighton (Thorncroft), May 17th, 1858, at Brighton (Bond), May 21st, 1858, at Bembridge (More), June, 1858 (recorded as *Hyles euphorbiae*), at Chickerell near Weymouth (Payne), July 9th, 1858, at Taylor Hill near Huddersfield (Carter), five at Countess Weir near Exeter, probably in May or June, 1860 (Potter), one in 1860 at Osborne, Isle of Wight (Winchester), May 12th, 1860, at Brighton (Thorncroft), May 14th near Exeter (Hellins), May 13th, 1860, in fine condition, at Torquay (Stewart), May 14th and 15th at Torquay (King), May 15th near Brighton (Swaysland), May 17th another at Brighton (Stewart), May 19th and 21st, 1860, at St. Leonards-on-Sea (Kent), May 20th at Lewisham (Stainton), and at Freshwater Downs (Bond), May 21st at Bembridge (More), two between May 17th and 26th near Brighton (Bond), June 13th, 1860, at Jersey (Johnson), January 28th, 1861, at Lewes (Blaker), February 2nd, 1861, at Torquay (Burt), April 16th, 1862, at Worthing, April 29th at Herne Hill (Wild), one seen April 29th, ♀ captured May 2nd, ♀ May 4th, 1862, near Plymouth (Bolitho *teste* Reading), May 4th, at Westbourne (Matthews), May 6th at Deal (Harding), May 14th, 1862, at Colchester (Bree), near Torquay (*Weekly Ent.*, p. 21), June 18th, 1863, at Woodbury (Greer), four near Killarney, 1864 (Birchall), September 10th, 1865, at Biggleswade (Whitaker), September 27th, 1865, in Yorkshire, bred from larva found on *Galium* (Gibson), October 17th, 1865, near Harrington (Tiltman), in October, 1865, at Guisbro' (Birks), May 3rd, 1866, at Brighton (Champion), one at Plymouth (Gatcombe), April 17th, 1867, at Stantonbury, near Wolverton (Barlow), May 8th, 1867, at Tiverton (Pole), May 11th, 1867, at Haslemere (Chandler), May 11th, 1867, at Ventnor (Keet), four May 15th, 1867, at Brighton (Thorncroft), May 14th, 1867, at Sudbury (King), May 17th, 1867, at Derriquin Castle on Kenmare river (Pasley), three or four ‡ in 1867, at Plymouth (Gatcombe), beginning of May, 1868, one at Plymouth (Gatcombe), July 19th, 1868, at Torquay (Grinstead), July 23rd, 1868, at Birstall (Binns), August 1st, at Weybridge (Barton), August 2nd, at Truro (Nix), August, 1868, at Middleton (Thorpe), August 2nd, 1868, near Derby (Balguy), August 3rd, 1868, at light at Wolverhampton (Morris), August 6th, 1868, at Guestling (Bloomfield), August 9th and September 26th, 1868, at Middleton (Taylor), August 10th, 1868, at Dunbar (Pearson), August 10th, 1868, at Cuckfield (Merrifield), August 11th and 15th, 1868, near Newport (Moberly), August 14th, 1868, at Wolsingham (Backhouse), August

‡ This record (*Entom.*, iv., p. 94) is most unsatisfactory. Of a species like *Phryxus livornica*, it appears absurd to record "three or four," as if the recorder did not know whether the preceding year he caught "three" or "four."

15th and 16th, 1868, near Kildare (Douglas), middle of August, 1868, at Niton (Clarke), August 25th, 1868, at Cheshunt (Boyd), August 29th, at Marlborough (Preston), in September, 1868, at Lewes (*teste* Knaggs), imago bred end of August, 1868, from larva found at Brighton (Tidy *teste* Lester), September, 1868, at Cheam (Brown), autumn of 1868, at Great Rissington (Todd), May 17th, 1869, at Folkestone (Ullyett), two about May 20th, 1869, at Lewes (Jenner), April 26th, 1870, at Waltham Abbey (Boyd), May, 1870, three at Bloxworth (Cambridge), May 27th, 1870, at Aldsworth (Todd), May 18th, 1870, at Sheldon, near Tynemouth (Jordan), May 22nd, 1870, two at Langharne (Kaye), May 24th, 1870, a ♂ at Edgbaston, May 31st, a ♀ at Bromsgrove (Enock), May 26th, 1870, at Folkestone (Knaggs), May 28th, 1870, at Colchester (Harwood), early June, 1870, at Kilkenny (Bristowe), early June, 1870, several at Mount Edgcumbe Park (Sturt), June 2nd and 3rd, 1870, at Dartmouth (Coles), June 13th, 1870, at Onchan (Roxburgh), bred August 11th, 1870, from fullfed larva obtained July 12th, near Saltash (Hobbs), August 13th, 1870, at Weston-super-Mare (Aldridge), six taken near Plymouth (Purdue), four in mid-August, 1870, at Plymouth (Rowe), August 20th, 1870, at Strood (Farrow *teste* Tutt), August 23rd, 1870, at Hunton, near Maidstone (Greville), August 24th, 1870, at Reading (Poulton), bred August 26th from larva spun up on July 27th, 1870, at Ryde (Farn), September, 1870, at Worcester (Gustard), September 17th, 1870, near Exeter, and October, 1870, near Plymouth (Hellins), October 2nd, 1870, at Dover (Eedle), one taken in 1872 at Ashford (Chittenden), May 27th, 1875, at Llantrissant (John), June 13th, 1877, near Bury (Kay), early August, 1877, at Shanklin (Billings), June 11th, 1878, at Knutsford (Sidebotham), June 15th, 1878, at Strood (Farrow *teste* Tutt), June 15th, 1878, at Burnage, near Manchester (Massey), July, 1878, on Town Moor at Hartlepool (Robson), August, 1878, at Borrowash (Mann), August 5th, 1878, at Hartburn, near Morpeth (Finlay), third week in August, 1878, Merthyr Mawr, Bridgend (Hampson), June 8th, 1879, June 11th, 1879, June 13th, 1879, at Torquay (Jones), June 11th, 1879, at Bournemouth (McRae), September 27th, 1880, at Bournemouth (McRae), June, 1883, near Box Hill (Paskell), June 29th, 1883, near Lindfield (Blaber), July 10th, 1883, at Bevingdean, near Brighton (*teste* Clark), July 11th, 1883, at Upton Park (Bond), July 15th, 1883, at Abingdon (Walker), July 30th, 1883, at Walthamstow (Harper), July 18th, 1884, at Gosport (Larcom and Pearce), July 26th, 1884, in Sandwich (Harbour), September 18th, 1884, at Dover (Webb), commencement of February, 1887, at Coles Cross, near Crewkerne (Helps), one taken at Plymouth in 1888 (Dawson), June, 1888, in New Forest (Carnegie), June 2nd, 1888, at Polegate (Ward), June 7th and 11th, 1888, in Ormeau Park (Watts), and one at Kingsdown (Kane), June 13th and 14th, 1888, at Pons-a-Verran, near Penrhyn (Mayne), early September, 1891, at Carrow, near Norwich (Laddiman), May 31st, 1892, at Winchester (Nevinson), June 4th, 1892, at Lyndhurst (Ward-Jackson), June 5th, 1892, at Sketty Park (Robertson), June 6th, 1892, at Rochester (Ovenden), June 8th, 1892, at Dorking (Flood), June 10th, 1892, at Headsnook, near Carlisle (Routledge), May 20th, 1893, at Christchurch (Ashford), May 25th, 1893, at Christchurch (Adye), five

specimens taken first week in June, 1894, and days following, at Wishanger (Bingham-Newland), in 1894 at Trim (Cuppage), June 7th, 1894, at Horrabridge (Still), June 7th, 1894, at Cofton, near Starcross (Benthall), July 7th, 1894, at Preston, near Brighton (Morris), June 2nd, 1895, at Egg Buckland (Briggs), July 1st, 1895, at Brighton (Morris), September 14th, 1895, at Dover (Webb), July 15th, 1896, at Hartlepool (Gardner), August, 1896, at Milford-on-Sea, near Lymington (Pattison), June 12th, 1898, at Portland (Hyde), May 27th, 1898, at St. Agnes, Scilly Isles (Frohawk), October 15th, 1898, at Kenley (Snell), May 12th and 23rd, 1899, at Douglas Head (Crennel), May 26th, 1899, one seen at Douglas Head (Murray), August 19th, 1899, at Limpsfield (Patterson), May 3rd, 1900, at Gorran, St. Austell (Newstead), May 9th, 1900, at South Petherton (Taylor), June 22nd, 1900, at Croydon (Gower), ♂ July 11th, 1900, at Wolstanton (Heale), July 11th, 1900, at Douglas Head (Clarke), June 9th, 1901, near Cambridge (Crisp), bred September 27th, 1902, from a larva taken at Starcross (Jäger).

LOCALITIES.—ANTRIM: Ormeau Park, Belfast (Watts). BEDFORDSHIRE: Biggleswade (Whitaker). BERKS: Abingdon (Walker), Reading (Poulton). BUCKS: Stantonbury, near Wolverton (Barlow). CAMBRIDGE: Cambridge (Jenyns). CARMARTHEN: Langharne (Kaye). CHESHIRE: Knutsford (Sidebotham). CLARE: Trim (Cuppage). CORK: Castle Martyr (Law), Cork (Clear), Youghal (Ball). CORNWALL: Saltash (Hobbs), Gorran, St Austell (Newstead), Pons-a-Verran, near Penrhyn (Mayne), Looe (Clogg), Scilly Isles, St. Agnes (Frohawk), Mount Edgecumbe Park (Sturt), Pennace Hill (Sanders), Truro (Nix), Pendarvis, Penzance (Noye). CUMBERLAND: Headsnook, near Carlisle (Routledge), Harrington (Tiltman), Lake district (Stainton), Maryport (Swainson), Workington (Mawson), Carlisle (Cooper). DERBY: near Derby (Balguy), Borrowash (Mann), Burton-on-Trent (Evans). DEVON: Plymouth (Rickard), Plympton (Purdue), Torquay (Jones), Horrabridge (Still), Woodbury (Greer), Tiverton (Pole), Cofton, near Starcross (Benthall), Starcross (Jäger), Egg Buckland (Briggs), Alphington (D'Orville), Modbury (Green). near Exeter (Hellins), Dartmouth (Coles), Countess Weir, near Exeter (Potter). DORSET: Glanvilles Wootton (Dale), Chickerell (Payne), Portland (Hyde), Bloxworth (Cambridge). DUBLIN: Howth (Hart). DURHAM: Hartlepool (Gardner), Wolsingham, Sunderland (Backhouse), Town Moor (Robson). ESSEX: Walthamstow (Harper), Upton Park (Bond), Colchester (Bree), Wakering (Dale). FIFE: Dunbar (Pearson). GLAMORGAN: Merthyr Mawr, Bridgend (Hampson), Llantrissant (John), Sketty Park, Swansea (Robertson). GLOUCESTER: Almonsbury (Hill), Bristol (Dale), Redland (Mayes), Great Rissington, Aldsworth (Todd). HANTS: Isle of Wight—Ryde (Farn), Shanklin (Billings), Osborne (Winchester), Bembridge (More), Freshwater (Rogers), Ventnor (Keet), Brightstone, near Newport (Moberly), Winford (Bromfield), Niton (Clarke), Wishanger (Bingham-Newland), Bournemouth (Sanders *teste* Raynor), Milford-on-Sea, near Lymington (Pattison), Lyndhurst (Carnegie), Portsmouth, Gosport (Larcom and Pearce), Winchester (Nevinson), Lyndhurst (Ward-Jackson), Christchurch (Ashford). HERTS: Cheshunt (Boyd), Slindon (Cherry). ISLE OF MAN: Douglas Head (Murray), Onchan (Roxburgh). KENT: Strood (Farrow *teste* Tutt), Rochester (Ovenden), Folkestone (Ullyett), Dover (Eedle), Sandwich (Harbour), Ashford (Chittenden), Walmer Castle, Deal (Leslie), Hunton, near Maidstone (Greville), Lewisham (Stainton). KERRY: Killarney (Birchall), Derriquin Castle on Kenmare river (Pasley). KILDARE: Kilkea Castle, near Kildare (Douglas). KILKENNY: Kilkenny (Bristowe). LANARK: Glasgow (Gray). LANCASHIRE: Chorlton, Withington (Edleston), near Bury (Kay), Burnage, near Manchester (Massey), Preston (Cooper), Horley, Hale (Gregson), Middleton (Thorpe). LEICESTER: Leicester (Stainton). MIDDLESEX: Harefield (Wall), Waltham Abbey (Boyd), Bethnal Green (Bramley), Hammersmith (Stevens). NORFOLK: Lynn (Curtis), Carrow, near Norwich (Laddiman). NORTHAMPTON: Peterborough (Dale). NORTHUMBERLAND: Hartburn, near Morpeth (Finlay), Sheldon, near Tynemouth (Jordan). PEMBROKE: Tenby (Fowler). [PERTH: Bridge of Earn* (White).] ROXBURGH: Hawick (Guthrie). SOMERSET: Coles Cross, near Crewkerne (Helps), Clevedon (Bracken-

* This record is erroneous, and was afterwards corrected to *Celerio gallii.*

ridge, Weston-super-Mare (Aldridge), Langport (Dale), South Petherton (Taylor), STAFFORD: Wolstauton (Heale), Wolverhampton (Morris). SUFFOLK: Sudbury (King). SURREY: near Boxhill (Paskell), Haslemere (Chandler), Croydon (Gower), Dorking (Flood), Cheam (Brown), Kenley (Snell), Herne Hill (Wilde), Weybridge (Barton), Limpsfield (Patterson). SUSSEX: Brighton, Cuckfield (Merrifield), Lindfield (Blaber), Bevingdean, near Brighton (Clark), St. Leonards-on-Sea (Kent), Preston (Morris), Polegate (Ward), Worthing, Ringmer, Firle, Lewes (Jenner), Westbourne (Matthews), Guestling, Hastings district (Bloomfield), Slindon (Fletcher). WARWICK: Birmingham, Bromsgrove, Edgbaston (Enock). WATERFORD: Newtown Hill, Tramore (Burkitt *teste* Wallace), WILTS: Marlborough (Preston). WORCESTER: Worcester (Gustard), Malveru Links (Edwards). YORKS: Barnsley (Stainton's Manual), Saltburn-on-Sea, Cleveland (I'Anson), Taylor Hill, near Huddersfield (Carter), Darlington (Backhouse), Birstall (Binns), Hebden Bridge (Gibson), Middletou (Taylor), Hornsea, near Hull (Inchbald), Guisbro' (Birks).

DISTRIBUTION.—One of the most widely distributed Sphingids, occurring throughout the whole of the warmer temperate and subtropical parts of Europe, Asia, Africa, and Australia, and extending as a migrant into the temperate regions. [In North America and the Pacific Islands it is replaced by the allied *P. lineata*.] In the Elburz mountains it has been found at an elevation of 12000ft. The species is only a true native of the most southern portions of the Palæarctic regions, the specimens taken in the central and northern areas being immigrants or the direct descendants of immigrants. AFRICA: Morocco—northwest districts (Blackmore), Tangier (Walker), Tunis (Oberthür), Bizerte (*teste* Bartel), Algeria, distributed—Sebdou, Oran (Codet), Biskra (Bleuse), Bon-Saada (Oberthür), Collo (Seriziat), Valley of Djebel-Amour (Lucas), Meridja (*teste* Bartel), Madeira (Baker), Canary Islands (*teste* Bartel), in the Red Sea (Manger), Khartoum (Brit. Mus. coll.), Cape Colony (Trimen), Bloemfontein at 6000ft. (*teste* Bartel), North Central Somaliland—Eyk (Peel *teste* Druce), Madagascar (Mabille). ASIA: Syria—Beyrout, rare, Haifä, Wüste near El-Arisch (Lederer), Asia Minor—coast of Sea of Marmora (Mathew), Cilicia—Amasia, Tokat (Lederer), Palestine, local—Jaffa, &c., common (Swinton), northwest Asia Minor—Brussa, Olympus Maghuisa, Smyrna, Aidin, Auatolia (Staudinger), North Persia, very common—Shahrud, Hadschyabad, Elburz Mts. at 12000ft. (Ménétriés), Astrabad, near Tschehar-deh, Tuieh (Bienert), Turkestan—Serachs, on the frontiers of north Persia and Turkestan (Erschoff), central Siberia (Alphéraky), southwest Siberia, Achal-Tekke district—Nuchur, rather common, Kisil-arwat (Christoph), Krasnowodsk, Mangyschlak peninsula, Pamirs—Kisilkoum (Grum-Grshmailo), British Beloochistan—Quetta, India—Sikkim (*teste* Bartel), northeast India (Koch), Cashmere, Darjeeling (Boisduval), northwest Himalayas, Aden, China (Hampson), Wei-hai-Wei (Fletcher), Wa-shan (Leech), Thibet—Ta-tsien-Lou, Te-Pin, Lou-Chan (Oberthür coll.). AUSTRALIA*: West Australia—Dunbrody (Brit. Mus. coll.), South Australia—Adelaide (*teste* Bartel). AUSTRO-HUNGARY: Taufers Valley, Innsbruck, occasional visitor only (Weiler), Bucovina, rare, but pretty constant resident (Hormuzaki), Pressburg (Rozsay), Bohemia—Carlsbad, Leitmeritz, one (Fieber), Galicia, very sparingly—Gruszów, Podgórze, Lemberg (Garbowski), Brody, Neu Sandec (Klemensiewicz), Stoposiany, one, Podhorodec (Nowicki), Moravia—Brünn, Grussbach (Müller), Salzburg (Fritsch), Epiries, rare (Husz), Gölnitz, three times (Hudák), Franzenshöhe, one (Wocke), Tyrol—very rare Bozen, Trient, Innthal, Pusterthal, Etschthal (Hinterwaldner), near Linz—Pöstlingberg, Ritzlhof (Himsl), Jaufen (Heller), St. Lambrecht (Kodermann) Lavantthal, occasionally common (Höfner), Vienna, singly (Speyer), Augsburg, Ottensheim, Buda (Speyer), Carniola—Wippach, Hungary—Puj, Rea, Hermannstadt, Klausenburg, St. Gotthard, Möszö-Zah, Transsylvania, Noság, Kaschau, Tavarnok, Grosswardein, Pápa, Fünfkirchen, Comitat Szerém, Croatia, Fiume, Buccari, Karansébes, Orsova, Bosnia—Dervent, Dalmatia—Obrovazzo Budapest (*teste* Bartel). BELGIUM: Huy, twice, Brussels, once (Donckier), Namur (Hedemann). BULGARIA: near Sofia, very rare (Bachmetjew). CHANNEL ISLES: Jersey (Johnson). CORSICA (Rambur). CYPRUS (Fletcher). DENMARK: Zealand—Nödebo (Bang-Haas). FRANCE: sometimes rather common in southern France, in Provence and Languedoc (Berce), dept. Lozère—Florac (Bellier de la Chavignerie), Pyrénées-Orientales—at summit of Canigou (Oberthür), once near Caen (Fauvel), Berry and Auvergne, occasionally (Sand), Eure-et-Loir (Gueuée), Haute-Garonne, common throughout dept.—Mont Cagire (Caradja), Puy-de-

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* *P. livornica* is also recorded from Polynesia—the Hawaiian Islands, &c., but the species that occurs here is *P. lineata*, the Nearctic and not the Palæarctic species.

Dôme (Guillemot), Var (Cantener), Morbihan—Vannes, fairly common, Ploërmel, rare (Griffith), Gironde, throughout (Trimoulet), Doubs (Bruand), Aude (Mabille), Loire-Inférieure, occasionally—Savenay, Nantes, La Chapelle-sur-Erdre (Bonjour), Saône-et-Loire, occasionally (Constant), Indre, near Blanc, not very rare (Martin), Deux-Sèvres (Maillard), Sarthe (Desportes), Digne, Marseilles, Aix, Pyrenees (Speyer), Cauterets, Montlouis, Hyères, Rennes (Oberthür), Montpellier (Chabrier), Cannes (Millière), Dax (Lafaury), Chartres (Guenée), Eastern Pyrenees—Gavarnie, at 4600ft., Mout Cenis (*teste* Bartel), Paris suburbs (Lucas), St. Cloud (Godart). GERMANY: only singly (Heinemann), Würtemberg, rare (Seyffler), Stuttgart, Reutlingen (Hoffmann), Alsace—near Huningue, La Vancelle (Berce), Mülhausen odd ones at Strasburg, &c. (Peyerimhoff), Hesse—Walderhausen, one (Glaser), Mecklenburg—Wismar, one (Schmidt), Bremen, one—Lilienthal (Rehberg), Thuringia, ocasional—Rudolstadt, several in 1883, Oberhain-bei-Königsee, Georgenthal, Gotha (Krieghoff), Erfurt (Knapp), Nassau, occasionally (Rössler), Saxon Upper Lusatia—Bautzen, one, Lichtenau, one (Moeschler), Posen—Ostrowo, Münster, Dresden, Aix, Weilburg, Offenbach (Speyer), Burghausen (Schrank), Chemnitz, as a visitor (Pabst), Berlin district, occasional (Pfützner), Silesia—Hirschberger Thal, near Tannhausen in Riesen-Gebirge, Mittelwalde an der Glatzer Neisse, Brieg, Breslau, Oels (Wocke), Magdeburg, Crefeld, Duisburg, Göttingen, Penig, Leipzig, Augsburg, Burghausen on the Salzach, Partenkirchen, Kempten, Memmingen (*teste* Bartel), Würtemberg—Reutlingen, Stuttgart, rare (*teste* Bartel), Baden, very rare—near Constance, Waldshut, Freiburg, Dinglingen, Carlsruhe, Heidelberg (Reutti), Frankfort-on-Main, Nassau—Wiesbaden (*teste* Bartel), Moselweiss, near Coblenz, Laubachthal, Rohrerberg, Bavarian Palatinate (*teste* Bartel). GREECE: Attica, rare, Corfu (Staudinger), Patras (Fletcher), also in Mediterranean 100 miles from coast of Greece (Fletcher). ITALY: throughout, not common in the north (Curò), Modena (Fiori), Sicily, somewhat rare—Madonie, Palermo, Monreale, Syracuse, Pantellaria, Anapo, Mondello, Palla-gutta valley (Minà-Palumbo), Roman Campagna, not common, near Boscolungo, very common (Calberla), Mont Cenis Pass, flyiug over by day, Lombardy, Piedmont, Liguria, Tuscany, very common—near Leghorn, Florence, &c., Naples (*teste* Bartel), Sardinia (Dahl), Aranci Bay (Fletcher). MALTA (Fletcher). PORTUGAL: Lisbon (Petiver). ROUMANIA: probably everywhere, in certain years common—Kloster Neamtz, Grumazesti, Costischa, Comanesti, Bucharest (Caradja). RUSSIA: Moscow govt., Ivanovsk, one (Assmuss), Crimea—Alupka (Melioransky), Caucasia (Eichwald), district of Lower Volga—govt. Kasan, Sarepta, common, in the Achtuba steppes, Caspian coast, not rare (Eversmann), Transcaucasia, distributed—Tiflis, Borjom, Derbent (Romanoff), Apscheron (*teste* Bartel). Circassian provinces (Kolonati). SCANDINAVIA: Ostergothland, one (Aurivillius), Hofby, one (Thedenius), Eneby (Kindberg). SPAIN: Andalusia—plains of Malaga, abundant (Rambur), Barcelona—San Gervasio, Calella (Cuní y Martorell), Gibraltar (Walker), Bilbao (Seebold), Tragacete (Chapman). SWITZERLAND: throughout, usually rare, occasionally more abundant in spring or autumn as an immigrant—Wolleshofen, near Zürich, common 1883 (Paul), Chur (Caflisch), Weissenburg, one (Huguenin), Bechburg (Riggenbach-Stehlin), Grisons—Chur, Flims, Serneus (Killias), Berne, Sollalex alp at foot of the Diablerets (Brown), Basel, Neuenburger See (Couleru), Schüpfen (Rothenbach), Gadmen—Steinalp to 6200ft. (Rätzer), the Aargau and Solothurn Juras, Lenzburg (Wullschlegel), Wipkinge, near Zürich (Zeller), Winterthur district (Biedermann), Pfäfters (Eisenring), St. Gallen, Canton Glarus (Heer), Mederaner-Thal (Wullschlegel), Uri, Vicosoprano, in Bergell (Zeller), Celerina, in Upper Engadine (Mengelbir). TURKEY: Both European and Asiatic sides of Sea of Marmora, Gallipoli (Mathew).

Genus: CELERIO, Oken.

SYNONYMY.—Genus: *Celerio*, Oken, "Lehrb. Zool.," i., p. 761 (1815); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, [Linn., "Sys. Nat.," xiith. ed., p. 802 (1767);] Rott., "Naturf.," vii., p. 107 (1775); Fab., "Spec. Ins.," ii., p. 147 (1781); "Mant.," ii., p. 95 (1787); "Ent. Syst.," iii., pt. 1, p. 368 (1793); [Schiff.,] "Schmett. Wien.," p. 42 (1775); Ill.'s n. Ausg., p. 14 (1801); Esp., "Schmett. Eur.," ii., p. 173, pl. xxi (1779); Bergstr., "Sphing. Larv.," p. 8 (1782); Retz., "Gen. et Spec. Ins.," p. 34 (1783); Bork., "Sys. Besch.," pp. 81, 140, 179 (1789), Brahm, "Insectenkal.," ii., p 314 (1791); Hb., "Eur. Schmett.," fig. 64 (1796); "Larvæ Lep.," ii., Sph. iii., Legit. B. d., fig. 2 *a—b* (*circ.* 1800); text p. 96 (*circ.* 1805); Schrk, "Faun. Boica," ii., pt. 1, p. 226 (1801); Latr., "Hist. Nat.," xiv., p. 131 (1805); Ochs., "Die Schmett.," ii., p. 217 (1808); [Leach, "Edin. Encycl.," ix., p. 131 (1815);] Dalm., "Vet. Ak. Handl.," xxxvii.,

p. 214 (1816); [Sam., "Ent. Comp.," p. 244 (1819);] Swains., "Zool. Illust.," i., p. 37 (1821); Godt., "Lep. Fr.," iii., p. 137, pl. xvii., fig. 3 (*circ.* 1822); Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); Meig., "Eur. Schmett.," ii., p. 137 (1830); Evers., "Faun. Volg.-Ural.," pp. 108, 110 (1844); H.-Sch., "Sys. Bearb.," ii., p. 87 (1846); Speyer, "Geog. Verb.," i., p. 319 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," i., p. 146 (1859); Bang-Haas, "Nat. Tids.," (3), ix., p. 402 (1874). *Hyles*, Hb., "Verz.," p. 137 (*circ.* 1822); Stephs., "Ill. Haust.," iv., app. p. 5 (1835); "List Br. An. Br. Mus.," v., p. 28 (1850). *Deilephila*, [Lasp.,] "Jena. Allg. Lit. Zeit.," iv., p. 100 (1809); Ochs., "Die Schmett.," iv., pp. 42, 43 (1816); Hb., "Franck Cat.," p. 87 (1825); Stephs., "Illus.," i., p. 125, pl. xii., fig. 2 (1828); "Cat. Br. Ins.," ii., p. 32 (1829); Dup., "Hist. Nat.," supp. ii., p. 158 (1835); "Cat. Méth.," p. 42 (1844); Dunc., "Brit. Moths," p. 147 (1836); Wood, "Ind. Ent.," fig. 15 (1839); Bdv., "Gen. et Ind. Meth.," p. 47 (1840); "Hist. Nat. Sphing.," p. 169 (1875); Humph. and Westwd., "Brit. Moths," i., p. 18 (1841); Assm., "Schmett. Schles.," ii., p. 33, pl. xii., figs. 36*a-d* (1845); Dbldy., "List Br. Lep.," p. 3 (1847); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Sta., "Man.," i., p. 94 (1857); Humph., "Gen. Brit. Moths," p. 10 (1860); Staud., "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 36 (1871); ed. 3, p. 102 (1901); Wallgrn., "Skand. Het.," i., p. 41 (1863); Snell., "De Vlind.." pp. 92, 95 (1867); Berce, "Faun. Franç.," ii., p. 20 (1868); Nolck., "Lep. Fn. Estl.," p. 88 (1868); Newm., "Brit. Moths," p. 8 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 119 (1872); Curò, "Bull. Soc. Ent. Ital.," vii., p. 110 (1875); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 569 (1876); Kirby, "Eur. Butts. and Moths," p. 70, pl. xviii., figs. 2*a-b* (1879); "Cat.," p. 665 (1892); Frey, "Lep. Schweiz," p. 57 (1880); Weismn., "Studies in Theory of Descent," transl. p. 211 (1882); Buckl., "Larvæ," &c., ii., p. 36, pl. xxiv (1887); Auriv., "Nord. Fjär.," p. 46 (1889); Minà-Pal., "Nat. Sicil.," ii., p. 133 (1888); Barr., "Lep. Brit.," ii., p. 42, pl. xlix (1895); Meyr., "Handbook," &c., p. 297 (1895); Lucas, "British Hawk-Moths," p. 95 (1895); Tutt, "Brit. Moths," p. 27 (1896); Bart., "Palæark. Gross-Schmett.," ii., p. 71 (1899). *Dilephila*, Hampson, Ind. Moths," i., p. 98 (1892); Kirby, "Handbook," &c., iv., p. 30 (1897).

The genus *Celerio* was described (*Lehrb. Zool.*, i., p. 761) in 1815, by Oken, as follows:

Halbbandierte, halbringleibige Schwärmer; Fleckenraupen. *Larva* with small, globular, not retractile head, body smooth, a caudal horn, coloured lateral spots. *Pupa* on the earth among leaves. *Imago* with interrupted rings on the sides of the abdomen; tongue longer; forewings elongate, smooth-margined, inner margin hollowed; antennæ of almost uniform thickness, scaled beneath, apex thread-like—*Celerio gallii, euphorbiae.*

The genus is, according to the showing of Weismann (larvæ) and Kaye (imagines), heterotypical, and we fixed the type of the genus (*anteà*, vol. iii., p. 355) as *gallii*. Kaye makes (*in litt.*) *gallii* the centre of a small group of Phryxids, which he defines as follows:

Head not prominent, nor markedly projecting; forewings not so long as in *Phryxus*, and less pointed; with oblique band from apex to near base giving off two or more short teeth or branches; spines on front tibia nearly all of uniform size—*Celerio gallii, euphorbiarum, zygophylli, ? opheltes.*

This he has now supplemented (*in litt.*) by a more detailed diagnosis, which reads:

Head not large, nor markedly prominent, but fairly pointed. Palpi bluntly pointed. Thorax broadest at costal base of forewing. Abdomen not long, tapering rapidly from the 4th segment to tip. Forewing of medium length, the costa straight to beyond the origin of 7, then very slightly curved, and finally sharply curved to apex. Outer margin slightly curved from apex to nervure 5, then straight to termen. In the ♀ the margin is straighter. Inner margin curved very slightly inwards soon after leaving termen. Nervures 7, 8 stalked, 9 from two-thirds length of cell. Cross-nervure of cell evenly curved inwards. Nervure 2 from well before half length of cell. An oblique band from apex to near base giving off two or more short tooth-like marks. Hindwing with costa evenly arched, apex very blunt; outer margin evenly curved to nervure 3, thence to nervure 1*b* considerably curved inward, forming a fairly sharp point at the extremity of nervure;

from *1b* to anal angle straight. Cross nervure between 7, 8 evenly curved, given off from less than half the length of cell; nervure 8 approximated to 7 just beyond the cell; 6 and 7 from upper angle; 5 almost equidistant from 4 and 6. Cross-nervure of cell forming a well defined S. Spines on front tibia nearly all of uniform medium size—*Celerio* (type *gallii*).

Weismann, on larval characters, does not quite get the same grouping as that suggested by Kaye. He notes (*Studies in Theory of Descent*, p. 224) the larvæ of the species of this group as being in what he terms the 6th phyletic stage, in which the larva has—

A single row of ring-spots replacing the subdorsal line.

Although *Thaumas vespertilio* and *Hyles mauretanica* fall into the same (*i.e.*, the 6th) phyletic stage of larval development, we find (*loc. cit.*, p. 358) that Weismann does not consider that they belong to the same genus as *Celerio gallii*, but he isolates the latter as a terminal form on its own particular evolutionary line. He also considers *zygophylli* (grouped with *gallii* by Kaye) as a terminal form on another line of development.

CELERIO GALLII, von Rottemburg.

SYNONYMY.—Species: *Gallii*, Rott., "Naturf.," vii., p. 107 (1775); Fab., "Ent. Syst.," iii., pl. i., p. 368 (1793); Latr., "Hist. Nat.," xiv., p. 131 (1805); Godt., "Hist. Nat.," iii., p. 37 (1822); Wood, "Ind. Ent.," p. 12, fig. 15 (1839); Staud., "Cat.," 2nd ed., p. 36 (1871); 3rd ed., p. 102 (1901); Bart., "Palæark. Gross-Schmett.," ii., p. 71 (1899). *Euphorbiae*, Linn., "Sys. Nat.," xiith ed., p. 802, in part (1767). *Galii*, [Schiff.,] "Schmett. Wien.," p. 42 (1775); Fab., "Spec. Ins.," ii., p. 147 (1781); "Mant.," ii., p. 95 (1787), &c. [NOTE.—All other references mentioned in the generic synonymy (*anteà*, pp. 167—168) are referable here to *galii*.]

ORIGINAL DESCRIPTION.—*Sphinx gallii.* Es ist dieses derjenige dem *Sphinx elpenor* so ähnliche Vogel, dessen der Hr. Hufnagel in der Anmerkung erwehnet, und dessen Beschreibung ich schon oben versprochen. Die Raupe desselben hat Rösel, tom. iii., tab. vi., figs. 1, 2, 4 abgebildet. Er hält sie aber für eine blosse Varietät der Wolfmilchraupe, und sagt, dass der daraus entstehende Vogel jenem vollkommen gleich, nur etwas dunkler sey. Allein so ähnlich dieser Vogel dem *Sphinx euphorbiae* ist, so unterscheidet er sich dennoch bey genauerer Betrachtung deutlich von ihm. Die dunkel-olivengrüne Farbe am obern Rande derer Oberflügel, macht nicht wie bey jenem einige abgesetzte Flecke aus, sondern nimmt als ein breiter gezackter Streif den ganzen obern Rand ein, und gehet von der Einlenkung bis zur Flügelspitze. Das Rothe derer Unterflügel ist nicht so lebhaft, wie bey dem *Sphinx elpenor*. Die Unterseite aller vier Flügel ist allemal bey dem *S. elpenor* rosenroth, oder doch röthlich, bey diesem Vogel aber siehet man nichts vom Rothen, sondern die ganze Unterfläche ist hier blass Olivengrün, oder vielmehr fahl, und die dunklen Flecke der Oberseite scheinen deutlich durch. Auch die Raupe ist sehr von der gemeinen Wolfmilchraupe verschieden, welches ein jeder aus der röselschen Abbildung wahrnehmen kann. Selbst an der Puppe zeigt sich eine Verschiedenheit, indem solche viel dunkelbrauner ist, als die Puppe des *Sphingis esulae.* Zu diesem allen kommt noch das verschiedene Futter derer Raupen. Die gemeine Wolfmilchraupe habe ich niemals, selbst durch Hunger dahin bringen können, dass sie von dem *Gallio* etwas gefressen, und die Raupe unseres jetzt beschriebenen Vogels, die sich bloss vom *Gallio* nähret, habe ich niemals zum Genuss der Wolfmilch bringen können. Sonst leben die Raupen zu einerley Zeit, auch

kriechen die Vögel zu einerley Jahreszeit aus. Doch sind mir Ao. 1771, 2 Stück von dem *S. gallii* vier Wochen nach ihrer Verwandelung ausgeflogen, nemlich im Aug. da die Raupen sich erst im Julio verwandelt. Es ist dieser letzte Vogel und seine Raupe ziemlich selten, und ich habe in keinem Jahre mehr als ein, höchstens zwey Stück davon gefunden, da hingegen die Wolfmilchraupe in hiesiger Gegend sehr häufig ist. Alle diese Umstände zusammen genommen, scheinen mir genugsamen Grund zu geben, diesen jetzt beschriebenen Vogel nicht für eine blosse Abänderung vom *Sphinx euphorbiae*, sondern für eine besondre Art zu halten, und ich nenne ihn daher nach dem Futter der Raupe *Sphinx gallii* (Rottemburg, *Der Naturforscher*, vii., pp. 107-108).

Imago.—62·5mm.—91mm. Thorax deep olive-brown, with white lateral lines from front to end of thorax, edged above with blackish; abdomen deep olive-brown banded alternately with black and white towards thorax and ringed with white towards anus, a median longitudinal dorsal row of white spots. Anterior wings deep olive-brown with a moderately wide oblique ochreous fascia from apex to inner margin near base, curved as it approaches inner margin, pointed towards apex, and extending somewhat wedge-shaped towards base, two irregular extensions on upper edge, one at end of discoidal cell, the other midway between this and apex; outer marginal area purple-greyish; fine inner marginal line white; basal patch of white scales; fringes unicolorous, dark ochreous-brown. Posterior wings with black base; central band creamy-pink, becoming quite red where it meets the white basal patch; black submarginal band (variable in width); outer marginal area pinkish-grey, speckled with dark scales; fringes white.

Sexual dimorphism.—The ♀ tends to be the larger, but there is very little difference in the general build, the more slender aspect of the ♂ is obscured in cabinet specimens by the contraction of the segments. The antennæ are longer in the ♂. The anterior tibial spurs are 2·2mm. long in the ♂, only 1·7mm. in the ♀, and the comb is more than proportionally reduced, occupying barely a third of the length of the spur, whilst the spines of which it is composed are short and hairlike. In the ♂, the comb occupies fully half the length of the spur and the individual spines look flat and are very unlike ordinary hairs, they are more than twice the length of those in the ♀ spur (about 0·2mm. and 0·1mm.). The ♂ possesses a scent fan consisting of a rather small wisp of hairs about 3·0mm. in length, enclosed in a pocket at the side of the first and second abdominal segments (Chapman).

Gynandromorphism.—The following is the only gynandromorphous example of which we can find any record:

a. Left ♂, right ♀. Incomplete gynandromorph, but more ♀; right antenna and wings strikingly longer, but not different in colour and markings; abdomen ♀. Bred. (Germar, *Meck. Archiv.*; Rudolphi, p. 54; Burm., p. 341; Hagen, *S. E. Z.*, xxii., p. 271, Schultz, *Ill. Woch. für Ent.*, i., p. 351).

Variation.—The species varies considerably in the depth of the ground colour, in the paleness of the outer marginal area, in the width of the oblique band, and in size. In some specimens the band is deep ochreous, others incline markedly to whitish-ochreous, ab. *pallida*, n. ab., whilst the two projecting teeth on the upper edge of the band vary

greatly in size, the lower, linear, discoidal one being sometimes almost obsolete, whilst the upper wedge-shaped one is sometimes well extended. The band frequently narrows at its base, towards the inner margin, the most remarkable aberration in this direction known to us being one that stops short just beyond the discoidal tooth, the position of its basal portion being occupied by the ground colour. This incomplete-banded form we term ab. *incompleta*, n. ab. In the hindwings also the more or less marked redness of the median area is very noticeable, and whilst, in some instances, the black submarginal band is narrowed to a mere line=ab. *stricta*, n. ab., in others it extends outwards to the cilia=ab. *lata*, n. ab. The variation in size is very remarkable, and, among our British-bred examples, we have specimens extending from 62·5mm. (the smallest ♂) to 91mm. (the largest ♀). Tugwell gives (*E. M. M.*, xxv., p. 284) some interesting details as to the size of some of the examples captured wild in 1888. He observes that the measurements of a number of continental *C. gallii* average ♂s 3ins.—$3\frac{1}{8}$ins., ♀s 3ins.—$3\frac{1}{2}$ins. Of the British-caught examples measured, all the ♂s and ♀s (except 2 ♂s) are 3ins. to $3\frac{3}{8}$ins. in expanse; on the other hand scarcely any of the many bred ♂s and ♀s reach 3ins., and only 2 ♀s exceed this measurement, the Liverpool collectors give $2\frac{5}{8}$ins. as the average for the bred ♀s and $2\frac{1}{2}$ins. average for ♂s; the Deal-bred ♀s averaged only $2\frac{5}{8}$ins; the Essex-bred ♂s averaged $2\frac{3}{8}$ins. the ♀s $2\frac{5}{8}$ins. These figures, Tugwell says, give an average of at least $\frac{3}{8}$ins. larger in the caught, over the bred examples, whilst the caught accord in every way with those reared from continental pupæ. In answer to the suggestion that bred insects are often undersized, Tugwell states that many of his larvæ were absolutely fullfed when found. He further states that the largest examples bred from English larvæ taken in 1888 were as follows: Liverpool—largest ♀, $3\frac{1}{8}$ins., largest ♂, $2\frac{5}{8}$ins.; Deal—largest ♀, $3\frac{1}{16}$ins., largest ♂, $2\frac{5}{8}$ins.; Essex coast—largest ♀ $2\frac{5}{8}$ins., largest ♂, $2\frac{3}{8}$ins. The imagines caught in 1888 were much larger, St. Margaret's—the largest ♀, $3\frac{3}{8}$ins., the smallest, $3\frac{1}{8}$ins., the ♂s $3\frac{1}{8}$ins.; Kingsdown—♀, $3\frac{1}{4}$ins.; Aberdeen—♀, $3\frac{1}{4}$ins.; Plymouth—♀, $3\frac{7}{16}$ins.; Dartford—♂, 3ins.; Dublin—♂, $2\frac{7}{10}$ins. Tugwell says that these caught examples agree in size with French ones, of which the ♀s are $3\frac{3}{8}$ins., and ♂s $3\frac{1}{8}$ins. full. Adkin gives further details on this point (*Proc. Sth. Lond. Ent. Soc.*, 1890, p. 75) which much modify Tugwell's statements and conclusions, and he states that the only inference that can be fairly drawn from these figures is that the insects captured in Britain more nearly approach those of known continental origin than do those bred in this country. We have since tested this by measurement and find that pupæ, obtained from the German dealers, give measurements varying from 65mm. (♂) to 90mm. (♀), *i.e.*, almost exactly the extreme measurements of our own British-bred examples. It is true that the majority of the wild caught immigrants are larger, heavier insects than the British-bred progeny resulting from them, but one suspects that this is entirely due to the artificial conditions of their rearing. As to colour-variation, Tugwell records two examples of an aberration bred in January, 1889, from pupæ resulting from larvæ obtained at Deal in September, 1888, in which the usual characteristic dark olive-green markings are replaced by dull grey, and the pale streak that runs from the inner margin to the tip of the

wing is obscured and dull in colour; the hindwings dull pale grey, lacking the usual rich rose shade at the anal angle; the body is also grey instead of olive-green (=ab. *grisea*, n. ab.). The scales in these examples appeared to be wanting in the ordinary pigment, and the scales themselves suggested immaturity, the larger longer basal ones adhering to the abdomen. Other semidiaphanous examples appeared among the later-bred of Tugwell's specimens, and these showed still more striking signs of failure in the scale-development. It is largely on the observations we made on the remarkable appearance of many specimens bred by Tugwell and others, in 1888, that we have founded much of our doubt in accepting strange-looking bred Phryxids with unusual facies, as hybrids (see *anteà*, pp. 44-54). Minà-Palumbo writes: "Dr. O. Struve reared from larvæ obtained at Mondello a form differing from typical *gallii* in the lack of the row of spots on the abdomen." Herz says that the form from the Lena district does not differ from that found in Europe and Amurland, whilst Staudinger makes a similar remark of a ♀ found at Saisan. Bartel notes (*Pal. Gross-Schmett.*, ii., pp. 73-74) that examples of *C. gallii* from the Kentei mountains scarcely differ on the upper side from European specimens, but, beneath, they are distinguished by a darker (blackish instead of dark grey) outer margin of the wings. He also adds that specimens from Labrador, where *C. gallii* is the sole representative of the Sphingids, are smaller than those of Central Europe, and considerably darker in colour; and that they also have an entirely red median band, and narrower, grey-dusted, margin to the hind-wings; on the underside a blackish marginal band is present on all the wings. He further notes that North American specimens agree almost exactly with the Labrador examples, and says that they are given in the catalogues under the name of *C. chamaenerii*, but he asserts that they differ too little from Palæarctic specimens for one to be able to regard them as a distinct species, and he thinks that the two can only pass for somewhat different forms of one species, brought about by climatic influences. This American form is now known as *intermedia*, Kirby, and almost all authors appear to be agreed that the American *intermedia*, Kirby (= *chamaenerii*, Harris), is merely a race of this species. Oberthür writes (*in litt.*): "I believe that *chamaenerii* is the same species as *gallii*. I have the North American form from Canada and Massachusetts." Kirby considers (*Cat.*, p. 665) the latter to be merely a variety and Staudinger adopts (*Cat.*, p. 102) the same view with the remark "al. post. magis rubrotinctis." The insect has been described as follows:

a. var. (an sp.) *intermedia* *, Kirby, "Faun. Bor.-Amer.," iv., p. 302 (1837); Kirby, "Cat.," p. 665 (1892); Staud., "Cat.," 3rd ed., p. 102 (1901). *Chamaenerii*, Harris, "Amer. Journ. Sci.," xxxvi., p. 305 (1839); Agass., "Lake Superior," p. 387, pl. viii., fig. 2 (1850); "Fern., "Sphing. of New Engl.," p. 145 (1886).—Expanse nearly 3ins. The upperside of the head and thorax is olive-brown, with a

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* *Deilephila intermedia* olivacea; alis primoribus vitta intermedia antice pallide rosea postice nigra; secondariis nigris fascia rosea intus, et ciliis albis. Expansion of the wings 2½ins. Taken in North America. This species is intermediate between *D. euphorbiae* and *D. galii*, which last it most resembles, but the anterior portion of the mesal stripe of the primary wings is pale rose-colour; the fringe of their inner margin, and of the posterior of the secondaries, is white; there is no series of white dots on the back of the abdomen, and the ventral segments are fringed at the apex with white hairs. This description was taken from an old specimen, apparently somewhat faded (Kirby).

white stripe along each side, which is edged with black on the upper side, along the thorax. The palpi are whitish beneath, and olive-brown above. The abdomen is olive-brown, with a row of small white spots along the middle; the 1st and 3rd segments are marked with black on the sides: the 2nd, 4th and following segments with white, some of them more or less suffused with pink. The uuderside of the thorax and the legs are of a dull yellowish-brown, and the abdomen is darker-brown, with white lines along the edge of the segments. The forewings are olive-brown, with a buff-coloured band extending from the hinder margin, near the base, to the apex of the wing; the lower edge of this band is slightly sinuous and the upper is irregularly indented; there is a black patch on the base of the wing and another at the end of the cell, and the termiual space and fringes are olive-grey. The hindwings are black, with a rose-red central band, which ends in a white spot on the hinder margin; the outer margin is narrowly edged with dull brown, which is sometimes stained with reddish; fringes white. LARVA: The mature larva is from 2½ins. to 3ins. long; the head is dull red, with a black stripe across the face; the upper side of the body is deep olive-green and polished, with a pale yellowish line along the middle of the back, terminating at the base of the caudal horn, and there is a row of pale yellow spots on each side from the 3rd to the 12th segments inclusive; these spots are placed on a wide blackish band, which crosses the forward part of each segment, and the sides of the body, below the spots, are thickly sprinkled with minute yellowish dots; the caudal horn is long, curved backwards, red, tipped with black, and with the surface rough; the spiracles are oval, yellow, and margined with black. The underside is pale pinkish-green, the true legs black, while the prolegs are pink, with a black spot on the outside of each. Transformations subterranean. FOODPLANTS: This larva feeds on the leaves of grape, *Œnothera biennis*, *Epilobium angustifolium*, *E. coloratum*. HABITS: Flies about flowers in the twilight in June and July (Fernald), at wild plum bloom *(Can. Ent.*, xxxiii., p. 99). DISTRIBUTION: Canada, Manitoba, Labrador, United States—New England, &c. (Fernald).

We have preferred to give Fernald's description of this insect, and Kirby's original description merely as a footnote, as this author states that his description was made from an old and faded example.

EGGLAYING.—In confinement, the moth lays its eggs singly, whilst hovering over bedstraw, willowherb, or fuchsia, holding, however, the plant with its legs during the process, but with its wings vibrating all the time; a few seconds suffices for laying an egg, when it is immediately off to another sprig of its foodplant. The egglaying period for a single moth often extends to three or four weeks, the ♀ appearing to develop eggs all the time, a total of 300 to 400 being reached for a single ♀, if properly fed, but if the weather be hot, and the feeding not up to their requirements, they will not lay more than 40 or 50 eggs, and will die within a week. The eggs are laid from early June until about the middle of July, and hatch, under satisfactory conditions, in about a week. The early-laid eggs often result in larvæ and pupæ that develop autumnal imagines (Head, *in litt.)*. Paget obtained eggs at Great Yarmouth, in August, 1834, from which larvæ hatched in due course *(Ent. Mag.*, ii., p. 435). May notes eggs laid in 1870 as hatching on August 16th *(Ent.*, v., p. 201). Jenner had eggs laid on August 24th, 1870, at Lewes *(E.M.M.*, vii., p. 213). Williams records that a worn ♀ laid about a dozen eggs at St. Margaret's Bay, July, 1888, and that seven hatched before August 8th *(Ent.*, xxi., p. 230), whilst Austen notes that three eggs laid by a ♀ on July 29th, 1888, hatched August 8th, at Folkestone *(l. c.*, p. 231).

OVUM.—Length almost 1·1mm., width just under 1mm. A flattened disc, inclining to circular in outline, exceedingly small for the size of the moth; a deep irregular depression on the upper surface;

pale green * in colour; surface somewhat shiny; apparently roughened; reticulation clearly distinguishable, and around the micropyle very distinct, the cells rather large where they surround the small micropylar depression and gradually decreasing in size outwards, the edges of the cells finely raised, somewhat whitish in tint; the shell transparent, the embryo clearly visible through the cell, as also are the bifid setæ arising from the tubercles. After hatching the shell is quite glassy and transparent. [Described July 25th, 1901, from eggs received from Mr. Head.] A rounded oval, depressed on one side; colour green, changing to transparent grey before larva hatches, length 1mm., width ·9mm., height ·8mm.; surface with a clearly-marked cell-sculpture, strongly so compared with the eggs of Amorphids and Eumorphids *(sens. strict.)*, the cells rather large, irregular, with slightly raised but broad edges, giving the egg a tessellated appearance (Bacot, July 17th, 1901). May notes eggs laid in August, 1870, as grass-green in colour, and rather small (*Ent.*, v., p. 201). Head sent us eggs, laid in confinement, and from foreign parentage, on July 13th and 19th, 1901.

Habits of larva.—In the first instar the larvæ are most difficult to locate with the naked eye, even when on only a very small fragment of a spike of flowers of *Galium verum* (Bacot). As they get older, they are not so difficult to find, but even then want closely searching for, and one sometimes, when turning over a plant, puts one's hand on an individual that had not been previously noticed, and they keep close to the foodplant until they are nearly fullfed. Syme notes *(E.M.M.*, ii., p. 6) that the larger larvæ generally are to be found in pairs, and that one being discovered a second is generally within a few yards, and he remarks that it appears strange that a larva, so large and so brightly coloured when fullfed, should be difficult to see, especially as it feeds quite exposed, yet it is so, more especially on the sandhills than on the shingle at Deal, and they are more easily traced by the frass which catches the eye more readily than the larva itself; the frass should be followed in the direction of its freshness, as the larva rarely moves more than a yard or two until it wanders for pupation. At Deal, on the sandhills, Syme observes that, in 1857, the larvæ were mostly found only on plants growing on loose sand without any covering of moss or herbage. In 1888, Tugwell notes *(Young Nat.*, ix., p. 237) that the larvæ were found at Deal, not only close to the sea, but also miles inland, by roadsides, as well as upon open ground, even basking on the footways; he states that the young larvæ were generally to be obtained on luxurious patches of the plant, but when nearly fullgrown they seemed to prefer more open places, where, by exposure, the plants get dwarfed and they can enjoy fully the direct rays of the sun; when quite fullgrown they are very fond of extending themselves on the bare and warm sand, in fact, their polished backs get quite hot, a condition which they evidently enjoy. The larvæ, when not feeding or basking, hide away most effectually, sometimes partly burying themselves,

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* Some years ago a ♀ caught at sugar at Leipzig deposited 5 black eggs as it was being taken out of the net, the eggs producing pitch-black larvæ, which remained very dark all their lives (Bartel *teste* Heyne). This record wants confirmation; it is most remarkable if a ♀ did lay black eggs; those that we have described were very typical green Sphingid eggs.

some being discovered almost covered with sand, which, in a few seconds more, would possibly have been quite hidden from view; 200 were taken, a large quantity of *Galium* being daily consumed, for the larvæ ate ravenously and fed up exceedingly rapidly. Arkle observes (*Ent.*, xxi., p. 257) that, in 1888, at Wallasey, the larvæ were most frequently found where the *Galium verum* grew thin and short, especially on mounds and rising ground in the hollows between the sandhills, and as near as possible to the sea, that the larvæ were fond of feeding, exposed in the hottest sunshine, and that the frass was to be looked for among the thin short bedstraw and followed up until the larva was seen. Porritt, too, observes that, at Deal, on August 30th-31st, 1888, larvæ of all sizes from about $\frac{3}{4}$in. to full growth (some of them being big, grand spotted fellows) were mostly found on the poor, short, sparse patches of white and yellow bedstraw, only three or four being found on big patches, and these exposed on the upper stems of the plants at Deal. Buckler notes (*Larvae*, &c., ii., p. 37) of some larvæ that he had between September 6th-26th, 1870, that they fed freely on the flowers, unripe seeds and leaves of *Galium verum*, and occasionally ate a little fuchsia, but that when large and fullfed they were restless and wandered about for a day or two before they settled down to spin their puparia, which they had all done by October 8th. Bacot says (*in litt.*) that the adult larva does not exhibit any tendency to shorten its thoracic and enlarge its front abdominal segments in the manner of the larvæ of *Eumorpha* (*elpenor*) and *Theretra* (*porcellus*), but that, if touched anywhere on the back or sides, it jerks its head fiercely backwards, striking the irritating object with its head or clasping it with its mouth and legs. These movements are made with surprising rapidity and vigour, and with quite sufficient violence to detach, if not to stun, any parasitic fly that might attempt to oviposit in it. On the other hand, Buckler's remarks (*loc. cit.*) suggest that there is some resemblance to the Eumorphine habit, for he says that, in form, they reminded him of the Chœrocampids, and that, although the thoracic segments are but slightly retractile, yet they are tapered off rapidly to the head, which is rounded and smaller than the prothorax, the rest of the body being tolerably cylindrical, &c. May observes that the larvæ almost invariably eat their cast-off skins. The years in which the species has been abundant in Britain have been 1859, 1870 and 1888. The following are some of the records of larvæ captured. Newman observes that, in 1855, many larvæ were taken on *Galium* on the coast sandhills, and in gardens on fuchsias. From August 29th to end of September, 1856, about a couple of dozen of larvæ were found on the Deal sandhills (Syme), whilst Farren records them from August 11th-24th, 1856, on the Gogmagog Hills, near Cambridge. At the end of September, 1857, larvæ again began to appear at Deal, and specimens continued to be found until the beginning of November, in 1858 three only could be found, and these in the early part of October, but, in 1859, by the second week of August, the greater portion of an extensive brood had evidently disappeared, and only some 40 or 50 larvæ were obtained during the remainder of August and the early part of September; searching in August, 1860, and September, 1861, failed to produce a larva, but three were taken at the end of August, 1862, and none again in 1863 and 1864 (Syme, *E. M. M.*, ii., p. 5).

The same observer adds that, from his observation, the larvæ may appear from the beginning of August to the end of October, and one can have no certainty in meeting with them even if one be in the right locality unless one is able to make a protracted residence in the spots where the species is expected to occur. In 1859, larvæ were taken at Ilfracombe on fuchsia (Mathew), at Shoreham on *Galium verum* (Rickman), at Eastbourne (Costick), at Carlisle (Armstrong), at Kilburn, in a garden, on fuchsia (Wormald), also on August 22nd, on fuchsia, at Bridgewater (Sanders), whilst Harding records six from Hackney, in a garden, on fuchsia during the first week of August, six more fullfed on *Galium verum* on August 12th, on the Deal sandhills, and four others between this date and September 10th in the same locality. Six larvæ also were obtained in Victoria Park, a day or so before August 4th, 1859 (*E. W. Int.*, vi., p. 160). Rogers recorded 36 larvæ, from near Dover on *Galium verum*, between August 1st-11th, and at Wallasey, August 20th, 24th, 26th, are given as dates of capture, whilst at Charlton a fullfed larva was found at the beginning of September (Potter), and Newman states (*Zool.*, p. 6693) that an unusual number of larvæ had been taken during the autumn on the southeast coast on *Galium*, and others on fuchsia in London. In 1870, larvæ were found much more widely distributed, and Newman says that they were extraordinarily abundant, hundreds of larvæ being taken. They were reported as occurring freely in the neighbourhood of Gravesend (Button), a larva taken as early as July 29th, 1870, in a garden at Plymouth (Bignell), six larvæ were found on August 28th, 1870, feeding on *Galium verum* on the Wallasey coast and several others later (Greasley), whilst Gregson notes that, to his knowledge, two individual collectors took 100, and 80 larvæ respectively, and others fewer numbers on the same stretch of coast. The larvæ from which Buckler's beautiful figures were made (*Larvae*, &c., pl. xxiv., figs. 1—1*g*) were also captured here between September 6th-26th, 1870. A nearly fullfed larva was taken on Durdham Downs on September 5th (Greene), another on September 7th, at Newcastle-on-Tyne, which went down on the 11th, whilst a small larva was found on the coast near South Shields about the middle of August (Hamilton), small larvæ found on September 9th on the shores of the Solway Firth were still feeding on October 14th (Robinson), larvæ taken September 18th, 1870, at Lewes (Jenner), three larvæ were taken on *G. verum* on September 19th, at Stanley-by-Perth (Marshall), and three larvæ were found between Glassmount and Kinghorn Loch in September and a fourth on October 3rd, which was still feeding on the 8th (Syme), &c. There is a record of 18 larvæ being taken near Brighton in 1871 (*E. M. M.*, viii., p. 112) by Edwards, but no further details are given. Eedle recorded three larvæ as being found in 1872, and Lawton records (*Yorks. List Lep.*, p. 18) a larva at Spurn in 1877. But 1888 was the great *C. gallii* year. The earliest larvæ appear to have been taken during the last week of August when Meek captured many examples on the shingle between Kingsdown and St. Margaret's Bay; and Porritt obtained a dozen larvæ on August 30th and 31st on *Galium* growing on the shingle near Deal and one in St. Margaret's Bay, whilst, on the same days, Tugwell took 11, making a total of 23; these larvæ varied much in size, and the

largest went down by September 14th; on September 11th, a search of about two hours on the same ground produced more than a dozen larvæ some of which were still quite small (Tutt), and Tugwell between August 30th and the end of September took some 200 examples in the Deal district. Many also were captured in other parts of the country—larvæ common during the last week of August, 1888, on *Galium verum*, and the following week about a dozen others were taken, on the sandhills near Shoeburyness (Cooper), larva on August 31st, 1888, on the cliffs at Cromer (Tawell), at Shoeburyness, full-fed larvæ were taken well on into September (Sheldon), larvæ on September 10th, 1888, at Reading, feeding on *Clarkia* in garden, not quite half-grown, were fullfed, however, by September 25th (Barnes); some larvæ were taken at Newmarket in September, 1888, almost in the town (Verrall), between September 4th-19th, 1888, on the sandhills at Wallasey, 35 larvæ were collected, twenty of which were retained and duly pupated, these pupæ kept in a warm kitchen, the first imago appearing October 29th, 1888, 16 others following between then and December 9th, when three living pupæ were left (Capper), in the latter part of September, seven larvæ were found at Lytham, and one at St. Anne's-on-Sea on September 27th, 1888 (Baxter), 22 larvæ were captured on *Epilobium angustifolium* at Risley Moss, near Warrington, September 22nd-26th, all the larvæ being taken in a bed of this plant some 50 yards long (Collins), September 8th-10th, 1888, 21 larvæ on the Wallasey and Crosby sandhills (Newstead), larvæ from September 8th-15th, 1888, taken by the local collectors in very large numbers on the Wallasey sandhills (Arkle), two larvæ feeding quite exposed in the bright sunshine on the sandhills at Hartlepool, September 23rd, 1888 (Gardner), over 30 larvæ were taken in August, 1888, round the coast of Morecambe Bay and Carnforth Marsh (Murray), and others in September, 1888, near Glasgow (Eggleton), two larvæ on September 13th, 1888, at Ramsgate (Buckmaster). One would possibly be well within the mark if one assumed that 600-1000 larvæ were obtained on the Deal, Essex and Cheshire coasts, of which possibly about one-third produced imagines. Cooper and Tugwell both failed to find a single larva in 1889 in the localities where the species was so abundant in 1888. Gregson's notice of larvæ (*Young Nat.*, x., p. 213) at Wallasey was later corrected, the larvæ turning out to be those of *Sesia stellatarum*, whilst the record of its occurrence at Deal (*loc. cit.*, x., p. 231) is very vague and not based on personal observation, so that the evidence available points to the 1888 immigrants having quite failed to establish themselves. On October 13th, 1892, a single black larva was taken at Chiswick (Sich), five larvæ were found in the autumn of 1894 on the Essex coast, but although several days were spent in seaching many miles of coast, no more larvæ were found (Harwood). In 1897, a single larva was taken at Starcross and spun up on August 13th (Benthall), whilst a larva was taken on September 14th at Wallasey, and three others on September 18th, 1897, at Waterloo (Moss). As to the appearance in abundance of the larvæ in 1888, the following notes are interesting: From imagines taken at St. Margaret's Bay between July 24th and August 6th, 1888, Williams obtained ova that hatched before August 8th. These larvæ are said to have been comparatively small when Porritt and Tugwell obtained at Deal, on August 30th-31st, almost fullfed larvæ, suggesting that

the moths were on flight and ovipositing some time before Williams and Oswald obtained their specimens (all ♀s except one). This view is strongly supported by Cooper's statement (*Ent.*, xxi., p. 257) that, at Shoeburyness, during the last week of August, he found the larvæ commonly, and that their traces hinted that they had been in great numbers, and that many had already pupated. Meek also records having taken 150 larvæ at Kingsdown before the end of August, and Greasley had fullfed larvæ on August 28th, and one would suppose that the bulk of the earliest eggs were laid all over those parts of Britain where the species occurred, by the middle of July. Such evidence as there is goes to support the suggestion that there is occasionally a flight of immigrant imagines into this country in July or August, that a comparatively few of these are captured in the ordinary way by collectors, that these immigrants find plenty of suitable spots in which to oviposit, that our summer is suitable to the growth of the early larvæ, but that our autumn is quite unsuitable both to larvæ and pupæ, that the late autumnal larvæ are killed off, and that the pupæ resulting from the earlier ones are unable to pass through our winter successfully in a state of nature. Want of sun would appear to be the greatest enemy to their continued existence in this country, certainly the mere low temperature of our winter is insufficient to explain their failure to acclimate themselves, if one considers fairly the winter temperature of some of their permanent localities in the Alps of Central Europe. That pupæ go over for many years, and then, as a result of unexplained and unknown causes, produce imagines in great numbers at irregularly recurrent long distances of time, is not worthy of consideration by scientific men, and has no atom of evidence in its support. As bearing on the meteorological difficulties the larvæ have to meet here, Hele observes that some 150 larvæ were obtained by himself and two friends at Aldeburgh in the autumn of 1888, and that, in the early part of October, when there were some frosty mornings, the mortality among them became great. Chappell notes (*Young Nat.*, ix., p. 238) that he found several dead larvæ at Blackpool in the autumn of 1888. Tugwell observes (*Young Nat.*, x., p. 44) that many of the apparently healthy larvæ that he obtained in 1888 died half-changed, and believes that the early cold of September paralysed them completely; he suggests that our early cold and wet autumns kill off wild larvæ. Arkle records (*Ent.*, xxi., p. 257) somewhat similar observations, and states that he came across many dead and dying larvæ when searching at Wallasey. No doubt climatic conditions are among the chief factors in preventing this species from obtaining a permanent footing in these islands. As to rearing the larvæ in confinement, Newstead notes that 21 were successfully reared in a strong box provided with a strong gauze covering and three parts filled with dry sand. They were supplied twice daily with fresh, "hard" food; the box was so placed as to catch all the rays of the sun, but was always put under shelter at night and also in wet weather; the larvæ seemed to revel in the hot sunshine, but became more or less torpid in wet cold weather and at the approach of night.

Larva.—*First instar* (July 17th, 1901): Of medium thickness, evenly cylindrical, with no distinct trace of tapering at either extremity, the anus blunt; lateral ridge well marked on thoracic,

poorly marked on abdominal, segments. Head of medium size, almost square in outline, but with rounded corners; colour pale delicate green, spotted or speckled with darker; a few scattered dark tapering hairs with dark bases; the antennæ short and stout, the basal joint particularly so. Body delicate whitish-green, showing white at the junction of segments; subsegments fairly marked; scutellum large but not conspicuous, owing to its resemblance in colour to rest of body; anal plates and plates at base of prolegs much more distinct owing to difference in colour; the caudal horn short, stumpy-looking, markedly distinct owing to its dusky colour contrasting with the tint of the body, conical, with a flattened top bearing two hairs (tubercles i) at summit with hardly a trace of a notch between them (marking it off clearly from such a species as *Hyloicus pinastri*, with its distinctly forked horn); the horn is roughened, not thorny, but covered with fine pyramidal granulations, and has the appearance of being hard and chitinous, the hairs at summit knobbed; the setæ are very short stumpy black bristles with large black chitinous bases; on scutellum and anal plates the hairs are slightly longer than on the rest of the body, and tapering, on the dorsal and lateral areas of the body they end in a knob; a faintly translucent-looking dark mediodorsal line is present; spiracles small, black-rimmed, those on 7th abdominal larger than those on abdominal segments 1—6, although not so large as those on the 8th; the prothoracic spiracle hardly so large as that on the 7th abdominal; a small white spot beneath the skin on meso- and metathorax marks the position of the aborted spiracle. On abdominal segments, tubercle ii is only very slightly exterior to tubercle i, and there are two subsegments between them; on the meso- and metathorax they are still distinctly trapezoidal in position, but are situated much closer together on adjoining subsegments; tubercle iii is close above the spiracle on the abdominal segments, but on the meso- and metathorax it is of a double character, and, in some cases, bears two hairs placed very close together; tubercles iv and v on abdominal segments are both below the spiracle, iv directly beneath on the middle of the central flange, and v very far forward on margin of segment on upper edge of flange; on the meso- and metathorax only one of these subspiraculars is present (its position suggests that it is v), but there are two similar tubercles (? vi) bearing hairs on ventral margin just above the legs; on the prothorax the prespiracular is a double tubercle; the skin-surface is smooth without spicules or secondary hairs; the 1st subsegment of abdominal segments is very large, probably composed of at least three conjoined, the following 5 subsegments are about equal, but less than half the size of the 1st. *Second instar* (August 2nd, 1901): The usual Sphingid change at 1st moult, *viz.*, multiplication of hairs (now of shagreen character), occurs; in form the larva tapers from the 8th abdominal forwards towards head; the head trapezoidal, with rounded edges, slightly notched at crown; both the shagreen and head hairs are black, short, spike-like, with a small black chitinous base; the skin-surface also thickly dusted with minute, black, ? chitinous specks, fewer in number or absent on the coloured stripes; caudal horn short and stumpy, of a dark purple colour; body colours dark dull green dorsally with a paler mediodorsal stripe, subdorsal and infraspiracular bands of whitish or cream colour,

the subdorsal sloping upwards at head and caudal horn (as in *Sesia stellatarum*), brighter yellow patches on the subdorsal band are now visible, situated on the enlarged 1st subsegment of the meso- and metathorax, as well as on abdominal segments 1-8. This enlarged 1st subsegment is clearly in some (and probably in all) cases, composed of three subsegments, thus making up the normal number of 8 found in Sphingid larvæ. The primitive setæ are still distinguishable owing to their larger size. *Third instar* (August 6th, 1901—described with hand-lens only): No. 1. The larva somewhat of the shape of that of *S. stellatarum* ; neat and compact without being either long or stumpy ; the caudal horn small, but well-developed, dark purple (almost black) for the upper four-fifths of its length, covered with numerous thorny-looking hairs. The head more rounded than in last instar and covered with many fine dark bristles or short stout hairs. The scutellar plate is conspicuous, being coloured similarly to the head and unlike the body ; the subdorsal bands do not reach it, the hairs on it are numerous, and agree with those on the head in colour and in the fact that there are no coloured shagreen-spots at their bases. The spiracles are white, edged with a purple-black chitinous rim, the larger size of those on the prothorax and 7th and 8th abdominals is still noticeable but not so marked as in earlier instars. The subsegments are really 8 (or even 9 if an obscure fold in the skin at the junction of the segments be counted) in number *; the first three are, however, poorly subdivided and form the large 1st subsegment, giving really 5 (or 6) small and 1 large subsegment. The shagreen-spots at bases of hairs are conspicuous, but on the enlarged 1st subsegment they have a tendency to weakness, especially on the dorsal area ; they are also inconspicuous behind the caudal horn ; these basal shagreen-spots are absent on the stripes, doubtless because the stripes were originally developed from the spreading of the coloration at the base of the hairs. There is a broad, well-developed, subdorsal, cream-coloured band which, near the horn, is bordered above by a darker margin ; on the subdorsal band are a series of bright yellow spots, which occur where the band crosses the 1st (enlarged) subsegment of each segment from the mesothorax to the 8th abdominal, inclusive ; these spots are oval rather than round and slightly broader than the band on which they are situated ; they are bordered above by a narrow dark line. There is also a broad, well-marked, infraspiracular band of pale yellow or cream-colour with a tendency to develop a bright yellow spot just beneath each spiracle, the spot surrounds tubercle iv, the only primitive seta that is now distinguishable (with a handlens) from the shagreen tubercles. The true legs are pale green. The larva just described in 3rd instar is of a pale bright green tint, slightly darker on dorsal area, and with a bright yellow-green dorsal stripe ; the head, scutellum and anus being of a paler and more pellucid green. [This is called No. 1 in the following notes. Two other forms are now described in the 3rd instar as Nos. 2 and 3.] No. 2 *in third instar*.—The head dark dusky green, dark olive (almost black) at crown and round the mouth-

* Each segment of the body, except the thoracic and posterior segments, has a very broad subdivision in front on the back, followed by six narrow ones, though, whilst the larva is very young, the two hinder folds are united into a broader one, the last wrinkle being smoothed out ; these wrinkles or folds extend as low as the spiracles (Buckler).

parts and cheeks. The scutellum also dark olive, almost black. The ground-colour of the body dark dusky olive-green, slightly paler on lateral area; a pale green mediodorsal band looks almost white against the dusky skin; the shagreen-spots show up very markedly against the dark ground-colour and also appear almost white by contrast therewith. The true legs, anal plate, and plates at base of prolegs are dark olive-green, almost black. (This is the most conspicuously marked of the three forms of the larva under observation.) No. 3 *in third instar.*—[This is a still further progression from the pale green form (No. 1) than is No. 2.] Head, scutellum, true legs, plates on prolegs and anus entirely black; the dorsal area without median stripe and shagreen-spots, though faint traces of latter are observable near the subdorsal bands, and a very faint mediodorsal band shows up just before moult. The colour of skin of so dark and dusky an olive tint as to be almost better described as black; the lateral and ventral areas, probably on account of the shagreen-spots being welldeveloped, look paler and greener, although the dark pigment under unspotted portion of skin is possibly not really less intense; the yellow subdorsal and infraspiracular bands are unaltered (as is also the case in No. 2), but they show up more brilliantly by contrast. *Fourth instar:* No. 1. Coloration and pattern now the same as those of Nos. 2 and 3 in same stadium. The ground-colour may be of a rather lighter shade of green and less dusky, whilst the bands and mediodorsal line are a little better marked, but, in all other respects, it is identical; there is a slight orange tint on the yellow spots, but not so well marked as in No. 3. Nos. 2 and 3 in *fourth stadium* (August 8th, 1901). The head, scutellum, and anal plate sooty-black, the body dark sooty-olive, almost black; both show a narrow, rather disconnected mediodorsal line (although completely absent in the last instar in No. 3). The subdorsal and infraspiracular stripes more or less broken into a chain of vivid yellow spots, more marked in the subdorsal than in the infraspiracular band; the bright yellow oval spots that occurred in the subdorsal band (on 1st subsegments) are now much enlarged, roughly oval in shape, and form the conspicuous feature of the larval coloration, the subdorsal band itself forming only a weak line connecting them. In No. 2 the subsegmental (1st) spots are pure yellow, in No. 3 the central area of each spot is orange-red. The tendency for the infraspiracular band to enlarge into a series of spots beneath the spiracle is still noticeable, but it is not further developed as is the case in the subdorsal series, there being a tendency for the whole of this band to degenerate. The coloured spots at the base of the shagreen-hairs form a very marked feature, existing as somewhat large pale yellow specks, but, although present on both the lateral and dorsal areas, they are absent on the dorsal area of the large 1st subsegment, the head, scutellum, 8th abdominal and anal segments; their presence on parts of the dorsum of larva No. 3 in this instar is noticeable in contrast with their entire absence in the preceding instar on these areas. Spiracles pure white, with a chitinous rim, their size more equal, although those on the 7th and 8th abdominal segments still remain somewhat enlarged. The caudal horn better developed than before, thick at base, tapering to a point, thorny, shiny, dark-coloured for the upper three-fourths of its length, but pale at base. *Fifth*

instar (August 17th, 1901): [All three larvæ are now alike, except that No. 3 has fewer shagreen spots; they are almost entirely wanting in this example on the enlarged (1st) subsegments, whilst in the others there is a well-marked fringe of spots bordering the enlarged 1st subsegment.] Colour and markings now brilliant and striking; rather stout, with medium-sized head (small when fullfed); body tapering considerably from the 7th abdominal; the anal segment long, but rather small, consisting chiefly of anal prolegs and flap; the caudal horn rather more developed than in last instar, bright coral-red in colour, raised on a low conical mound and curved backwards much as in larva of *Sphinx ligustri* (in one bent backwards almost horizontally), shiny, chitinous, thorny, with twin-like hairs arising from tubercular bases at summit. Head much rounded, but with tendency to trapezoidal shape in frontal outline, partly retractile, appears fairly smooth to naked eye, has in reality a fine granular surface; colour deep salmon-pink; the base of antenna and labrum white, other mouthparts, tips of antennæ, and broad band just above mouth black. The skin of the body is shiny black (like black satin), the scutellum and anal plates deep brick-red. The legs and prolegs black, the feet red. Neither infraspiracular nor subdorsal bands present; the subdorsal spots variable in shape on the different segments, on the meso- and metathorax they are rather small and elongated vertically, on the abdominal segments the spots become larger as they go backwards, getting longer, more elongated into oval outline, with the longer axis horizontal until that on the 8th abdominal segment becomes a broad, short, slanting slash at base of caudal horn, their colour pale shiny yellow; these spots form the characteristic feature of the larva in this stadium. The coloured bases of the shagreen-hairs are large and form distinct yellow spots; they are, however, almost or entirely absent on the area of what was formerly the subdorsal band, and are also wanting on the latter two-thirds of the enlarged 1st subsegment (in reality the 2nd and 3rd subsegments); these shagreen-spots become small and fade out on the ventral area. The spiracles large, white, slightly tinged with yellow at edges, the whole surrounded by a black rim. The hairs are minute, black, rather larger on head, front of scutellum and anal plate than elsewhere. The entire absence of the mediodorsal band and the red central shading to the dorsal spots (both marked characters in the preceding stadium) is very noticeable (Bacot). Smooth, elongate, attenuated anteriorly, of a fine olive-green colour, more or less speckled with yellowish-green; an interrupted dorsal line of dull pink, and, on either side, one of bright green, meeting the dorsal one at the head; the lower half of the body and abdomen pale yellowish-green; a series of large pyriform patches of a yellow colour, bordered by black, with a brown-red spot in the middle of each; these spots lie in the dorsal lines which meet on either side of the dorsal horn; those on the middle segments are the largest and brightest; a lateral line of yellow, having on the segments a pinkish-red speck, on which are the stigmata; a pale yellow ventral line; legs yellowish, true legs tipped with dark brown. Head slate-colour, with the mandibles black, labrum green, palpi yellow, tipped with brown, escutcheon fine green, with a slate-coloured oval patch on it; anus with a slate-coloured patch above; caudal horn brown, tipped and granulated

with black; stigmata light orange, bordered with black (Chaumette, *Zool.*, ix., p. 3160). Newman describes the larva (*Ent.*, v., p. 192), and Robinson gives some details of the larva in three instars (*E.M.M.*, vii., p. 187).

Variation of larva.—We have already detailed (*antea*, pp. 180-181) Bacot's description of three different forms of the larva in the 3rd instar, the individuals not being so unlike each other in the 1st and 2nd, nor again in the 4th and 5th, instars. Many authors have dealt with the variation, and Buckler gives (*Larvae*, &c., ii., pl. xxiv., figs. 1—*1g*) some excellent figures of different forms thereof in his possession. He describes (*loc. cit.*, pp. 37-40) an example (one of six*), sent to him in September, 1870, and which he regards as the type, as follows: "This larva, on its arrival, was about three-quarters of an inch in length (in *3rd instar*), of a rather bright, full, opaque green, the belly and legs a little paler than the back and sides, with dorsal, subdorsal and subspiracular stripes of pale ochreous-yellow. Upon the subdorsal stripe, on the front of each segment, appeared an indication of an oval spot of a little deeper yellow, with the faintest possible outline above of black; the horn at this time, but slightly curved, semitransparent, and of a reddish tint, tipped with crimson; the hinder wrinkled portions of the segments dimly showing some whitish-green freckles. On moulting (into *4th instar*) it changed into a deeper, brighter, and purer opaque green dress, in which the previous design was now deeper than that of the side, and the belly and legs a little paler still. On the subdorsal stripe, at the beginning of each segment, the oval spots were enlarged and tinged with bright orange, edged above and below with black; the end of the stripe, towards the horn, bore something of an elongate pear-shaped spot. A freckling of pale yellow specks distinctly appeared on the hinder portions of each segment, as well as on the sides; the spiracles white, outlined with black; the head pale bluish-green, marked with black near the mouth; a pale bluish-green plate on the second segment; hinder extremities pale green, slightly tinged with pink; the horn pinkish-ochreous, tipped with deep crimson. When a length of an inch and a quarter or thereabouts is attained the final moult (into *5th instar*) takes place, and a great change is at once apparent; the stripes have now totally disappeared, and the head, the plate on the second segment, and the anal flap and prolegs, show purplish-red. In the individual whose changes I have been tracing, the ground-colour at first was opaque-black, relieved only by the pale yellow subdorsal spots, a few small freckles and the spiracles; but investigation with a lens disclosed an infinity of little puckers and wrinkles, reminding one of the texture of crape. By degrees these wrinkles were smoothed out

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* Buckler must have obtained more specimens afterwards for it is recorded (*Trans. Ent. Soc. London*) that McLachlan exhibited at the meeting of the Ent. Soc. of London, held on November 7th, 1870, no fewer than 16 different forms of the larva figured by Buckler, and all found in 1870. Tugwell writes: "The larvæ vary immensely in colour and marking, and not only include the eight forms figured in Buckler's *Larvae*, &c., ii., pl. xxiv., but also several others. In some, the usual pale yellow or creamy-white subdorsal spots were replaced by a bright rose-pink colour. Three larvæ were entirely black, without any markings; and two, halfgrown larvæ, had the subdorsal markings much freckled with violet, making them extremely handsome."

as the creature grew, and the final dress was assumed." He then describes this same larva, when mature, as follows: "Length, when stretched out, two inches and seven-eighths. The back and sides of deep bronzy olive-green, but below the spiracles and on the ventral surface the colour is a smoky deep purplish-pink; although the boundary is clearly defined, yet a gleam of the one colour tinges almost imperceptibly the other, both above and below. There is no subdorsal line, but, in its place, a row of fourteen somewhat roundish spots; four of those on the thoracic segments are small, the others large, the hinder one somewhat pear-shaped, pale golden-yellow in colour, and set in transverse ovals of deep black, which melt into the ground-colour; the spiracles yellow, outlined with black, and surrounded by a cloud of darker olive than the ground-colour; a few small yellow specks are sprinkled along the sides. One can well make out a thin dorsal stripe of deep ochreous-olive, wide at the beginning of each segment, looking as if it were showing dimly through the surface from a depth below. The head is purplish-pink, the mouth black, with a streak of pale yellow above it, and yellow bases to the papillæ, and just above them is a narrow circumferent band of black. The plate on the second segment, the anal flap, and the prolegs are dark pinkish-red; the anterior legs black, the ventral prolegs purplish-pink, with an outward bar of black near their extremities; the horn is semi-translucent and blood-red; the whole surface of the skin, excepting on the thoracic segments, is now brilliantly polished, and resplendent with the play of light at every movement." Taking the above as the type, his larvæ divided into two other main sections as to ground-colour—the pale olive and the black, and each of these (as well also as the dark olive type) furnished a further variation in points of detail. These worked out as follows:

1. Neither a light nor a dark olive-green, but between them; the large yellow spots developed into pear shapes, the small end of each projecting forwards as a spot on the segment in advance.

2. Dark reddish-brown, with just a tinge of olive, and with the addition to the usual obscure dim dorsal line of a bright pale ochreous mark at the beginning of each segment, terminating at the end of the broad first subdivision, which appears like a black band; the bright yellow subdorsal spots as before.

3. The ground-colour of the back and sides a pale brownish ochreous-olive; the subdorsal pale primrose-yellow spots and the spiracles environed with black; the belly and prolegs rose-pink.

4. A deep jet black on the anterior segmeuts, bluish-black on the others; the head, thoracic plate, and anal extremities of very dark purplish-red; the subdorsal spots of a dirty and dingy yellowish-drab tint, with their centres more or less filled up with blackish-brown, in one or two instances wholly obliterated.

5. Ground-colour entirely bluish-black, the deepest tinge of purplish-red on the head, the plate behind, and the anal flap, which, with the subdorsal spots, the spiracles, and an extensive irroration of small dots, are all of the purest pale golden-yellow, the black ground being left unbroken as a band across the back from one subdorsal spot to the other.

Buckler then states that, in every instance, the skin, after the last moult, was black for a day or two, as previously mentioned; but, at this time, one may judge of the colour the larva will eventually assume by the tint of the head, thoracic plate, and anal extremities; these parts, if then quite black, indicate that the ground-colour will be black to the end of its career; but if they are of deep purplish-red, the larva will turn to a dark olive or brown; or should they

be of a bluish-green slightly tinged with pink, a pale olive larva will result. He further notes that, besides the forms described above from living larvæ, he observed amongst some figures lent him by Syme, one of a black variety, with the subdorsal spots of a dull crimson colour. He adds that Syme has had altogether about 200 larvæ, and says "head always red," whilst Stainton, in his notes made from living larvæ, says "head pale greenish," with the memorandum that Sepp's figure came nearest to his specimens. Bartel (following Steinert) writes *(Die Palaeark. Gross-Schmett.*, ii., p. 72) as follows: "The larva varies much. Among the *young larvae* 3 principal forms are distinguishable: (1) A dark green form, with light dorsal, subdorsal, and spiracular lines, otherwise without markings. (2) Blue-black, with connected sulphur-yellow spots. (3) The third form is green, with the usual yellowish stripes, of which the middle one is, on each segment, a little mixed with orange-colour or red. The *full-grown larva* is 80mm.—90mm. in length, and is subject to very manifold variations. The colouring is mostly either: (1) Green-yellow. (2) Dark green. (3) Blue-black. On this ground-colour there are either yellow or rose-coloured spots, which are commonly granulated with black. The larva is mostly lighter or darker green, with a yellowish lateral stripe and a whitish mediodorsal. On each segment stands a dark yellow light-margined spot. The horn is red, with the tip black. Spiracles yellowish, broadly bordered with black. Belly reddish-grey, head and thoracic legs blue-grey. Another common form is blackish olive-green, with yellow dorsal stripe, which, however, may often be wanting, and large, round, light or dark yellow spots, margined with black. The body is densely covered with black dots, and, beside the legs, is coloured dirty red or reddish-yellow. Not rarely also a glossy black-grey form of the larva is to be met with, which is densely covered on the sides with black dots. The dark forms of the larvæ have been incorrectly pointed out as stung. Newman, in describing the larva *(Ent.*, v., pp. 191-192), notes, among other interesting details, that the caudal horn differs in length in different specimens; in some it is very short and stumpy, while in others it forms a regular and rather elegant curve, and every intermediate gradation of form occurs, whilst the colour of the larvæ also is variable. He states that three specimens under examination have the ground-colour dull black, but the ground-colour is in some so light as to approach pale wainscot-brown. These three specimens also vary in other respects:

1. Has a red head and horn; a narrow mediodorsal stripe of pale canary-yellow; a lateral series of 10 rose-coloured spots on each side, 9 of which are nearly circular, and the 10th somewhat pear-shaped, the smaller extremity extending to the base of the caudal horn, and a narrow lateral stripe in the region of the spiracles almost white. The rose-coloured spots are connected by a series of smaller yellow spots, five of which intervene between each two of the former, thus forming a continuous series of spots, which commences on the 3rd segment and terminates at the base of the coral-red caudal horn. After moulting the dorsal stripe disappeared.

2. Has a reddish head and horn, no stripe on the back or sides, but a conspicuous series of 10 yellow spots on each side.

3. Has a black head and horn; no trace of the dorsal or lateral stripes or of the circular paler spots.

The three examples agree in having numerous white dots in the

neighbourhood of the spiracles, which are very light coloured; the 2nd segment (prothorax) has something like a dorsal plate, which is pitchy-red; the ventral flap and claspers are of the same colour; they all have a yellowish-white labrum, and the base of the antennal papillæ is of the same colour. Collins notes some larvæ taken by him near Warrington, as black when captured, but says that they assumed a greenish hue, the black round the pale spots retaining its colour and giving the spots the appearance of having a black ring round them (*Young Nat.*, ix., p. 204). Syme asserts that, when fullfed, the male larvæ are paler than female larvæ, and that isolation of a number of the paler larvæ resulted in male moths being produced therefrom.

Development of larval markings.—Bacot's account (*suprà*) is the first detailed description of the larval ontogeny that has been published. From this we learn that the appearance of the larva varies at each instar as follows: *First instar:* Pale green, with dark mediodorsal line. *Second instar:* Dark dull green, a paler mediodorsal stripe, subdorsal and infraspiracular whitish bands, with brighter yellow patches on subdorsal, the precursors of the characteristic yellow spots that appear later. *Third instar:* Variable in colour, a pale mediodorsal stripe, a strongly marked creamy subdorsal band with bright yellow oval spots on the enlarged 1st subsegments of each segment, also an infraspiracular line with a tendency to develop a bright yellow spot beneath each spiracle. *Fourth instar:* More uniform again, a narrow disconnected mediodorsal line, subdorsal line broken into a chain of yellow spots with orange-red centres; the infraspiracular band also broken. *Fifth instar:* Subdorsal, mediodorsal, and infraspiracular lines absent; the subdorsal line of spots strongly developed but without orange-red centres. Syme observes (*E.M.M.*, ii., p. 7) that, when young, the larva of *Celerio gallii* is exceedingly like that of *Sesia stellatarum*, of the same size, being pale or dark green, with a white lateral stripe, but the caudal horn is not blue at the apex as in that species. The yellow spots, he says, sometimes do not appear till the last moult, but generally become apparent at the second ecdysis. May observes (*Entom.*, v. pp. 201-202) that larvæ of a dull pale green colour emerged from eggs August 16th, 1870. *First moult* occurred August 23rd, the larvæ then becoming brighter green; dorsal, subdorsal, and spiracular lines slightly indicated, being of a lighter colour; dorsal area darker green; horn blackish. *Second moult* occurred August 29th, the larvæ now grass-green, the dorsal area darker; a narrow yellowish-green dorsal line; subdorsal and spiracular lines pale yellow, edged with black on the upper sides; ten oval yellow spots, one on each segment, in the subdorsal line, between which and the legs the surface is profusely sprinkled with minute light-coloured specks. *Third moult* took place on September 3rd; many specimens of a deep sea-green, some lighter and some darker; the dorsal area always darkest; dorsal line greenish-yellow; subdorsal and spiracular lines yellow; the ten oval spots larger and of an orange colour; spiracles white; horn black, with the base dirty yellow; head grass-green; edge of mouth black; prolegs black; some specimens entirely black with the beforementioned coloured markings; all have the whole surface sprinkled with more distinct minute pale-coloured specks, most numerous between the subdorsal line and legs. *Fourth moult* took place Septem-

ber 12th (Of the appearance in this, the 5th instar, May gives no account). The markings of the larva of this species appear to be developed in a precisely similar manner to those of *Thaumas vespertilio (vide,* Weismann, *Studies in Theory of Descent*, pp. 210-211). He says that the adult larva, as in that species, shows no trace of a subdorsal line. A row of large black spots, each having an irregular, round, yellowish-white nucleus is situated on an olive-green, blackish-brown, brown, or dirty yellow ground. A figure of a larva by Hübner is 2·5cm. long, of a light green colour, with five longitudinal lines—one dorsal, two subdorsal, and two spiracular lines. The subdorsal is white, and bears, in the place of the ring-spots, small red dots, whilst the line itself is bordered with black where the red spots are situated. Hübner's figure is possibly of the *3rd stage*, so that it is probable that, in the second stage, there is a subdorsal line either quite free from spots, or only showing such feeble rudiments* as are to be seen in the 2nd larval stage of *T. vespertilio*. Of two larvæ in the *4th stage*, found in the Upper Engadine, one (fig. 45) was 3·3cm. long, already of a dark, blackish-green ground-colour, with a broad greenish-white subdorsal line sharply defined throughout its entire length, and containing ring-spots of a sulphur-yellow, with an orange-red nucleus; the black "ground-area" did not encroach upon the subdorsal line, but was confined to two faint crescents situated above and below the "mirror." Only the two foremost "mirrors" (on the 2nd and 3rd segments) were without nuclei. The remaining peculiarities of coloration are shown in the figure. The shagreening is present on the sides and a portion of the under surface. A second example was 2·8cm. long, essentially similar to the former, but was pitchy-black, with a very indistinct subdorsal line and a few ring-spots, the "mirrors" of which were also sulphur-yellow, with an orange-red nucleus. The shagreening was quite as strong as in the first specimen, the dots being yellow instead of white. It is specially to be observed, because of its important theoretical bearing, that, in this larva, the ring-spots were absent on the front three segments, and on the fourth only a faint indication of one could be perceived. In the larva figured, the ring-spots increase also in distinctness from the tail to the head. *5th stage*: The two specimens just mentioned, after moulting, acquired the well-known markings of the adult larva, already briefly described above. The 5th is the last stage. The larva is known to occur in several varieties, Rösel having figured it in three forms—light green, olive-green and dirty yellow. Having had an opportunity of observing 25 adult specimens at one time, I am able to state that it is not in this instance di- or polymorphism†, but a case presenting a great deal of variability, with which we have to deal. There are not several sharply-defined types of coloration, but the extremes are connected by numerous intermediate forms; the extreme forms, however, certainly preponderate . . . Among the 25 larvæ, all gradations of colour, from pitchy-black to light clay-yellow, occurred, and even to an almost whitish-

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* This is so. See summary *(suprà* p. 186*)*, where it is stated that the indications of the spots only are to be found in the 2nd instar.

† Weismann appears here to use the term polymorphism in a restricted sense, and to exclude those cases where many marked types are joined by intermediate forms.

yellow; some were brownish-black, others of a beautiful chestnut brown, others yellowish-brown, dark clay-yellow or brownish-red. Of 21 specimens, of which the ground-colours were noted, 9 were black, 9 clay-yellow and 3 brown, whilst each of the three again showed various minor modifications of colour. The other colours also varied somewhat. Thus, the "mirrors" were sometimes white, sometimes strong yellow, and, occasionally, they also contained a reddish nucleus. The variation in the shagreening was especially interesting, inasmuch as these appeared to have a striking connection with the general colouring of the larva. Black specimens seldom show such sparse shagreening as that represented in pl. v., fig. 46, but are generally thickly scattered with large shagreen-dots right up to the dorsal line (pl. vi., fig. 47), these strikingly resembling the adult larva of *Hyles euphorbiae* *. The light ochreous-yellow individuals, on the other hand, were sometimes entirely without shagreening (pl. vi., fig. 48), being smooth and much resembling the light ochreous-yellow or yellowish-red larva of *H. nicaea* (pl. vi., fig. 51). I have never seen a larva of *C. gallii* which showed traces of the subdorsal line in the last stage†, nor have I ever met one which possessed a second row of "mirror" spots, so that retrogression or a sudden advance in development does not appear to occur. The adult larva of *H. mauretanica*, which likewise belongs to the *gallii* group, is very similar to that of *H. euphorbiae*, but differs in the absence of the second row of ring-spots. For this reason it must be regarded as a retarded form at an older stage of phyletic development (Weismann, *Studies in the Theory of Descent*, pp. 213-215).

Cocoon.—The larvæ make for their puparium a rather coarse network of threads, which binds the sand beneath them with the *Galium* above into a slight cocoon; those I had, had all retired by October 8th (Buckler); the larvæ spun up on the surface of the sand on which the food was placed (Benthall); cocoons slight and spun on the surface of the earth of the breeding-cage (Barnes); three or four larvæ (in confinement) pupated in the sand about an inch below the surface, the remainder spun slight cocoons on the surface, mixing with them portions of the food-plant, &c., and therein pupated (Newstead); the larvæ spin the leaves of the foodplant together, just under the surface of the ground (Foster). Tugwell notes that several larvæ that he had in 1888 spun up just on the surface of the ground, but that the greater number had simply formed a loose cocoon amongst the stems of the foodplant, whilst six pupated from one to two inches beneath the soil, and had formed fairly compact cocoons of silk and grains of sand.

Pupa.—After a somewhat prolonged examination of the pupa in comparison with that of *Hyles euphorbiae*, I find them to be extremely alike, and that they differ only by one or two very trifling details. [Whether a larger number of specimens than have been examined would show these differences to be merely varietal and not specific, or whether some more definite point of distinction would appear I cannot, of course, say.] The sculpturing of the surface of both consists of numbers of pits on the abdominal segments, these are alike in both, in size and depth, and in a tendancy to lose their posterior lips, and of the anterior lips to run together into a line of arches.

* See also Buckler's *Larvae*, &c., pl. xxiv., figs. 1*c* and 1*f*. In fact, the whole of Buckler's figures on pl. xxiv illustrate this point excellently.

† Buckler's pl. xxiv., fig. 1*c*, gives some traces of this line.

The peculiar character of the sculpturing in front of the spiracle of abdominal segment 5 is usually repeated in *C. gallii* in 6 and even in 7. In *C. gallii* there is often a definite little spine at the mandibular angle of cheek, and the anal spine is rough almost to the tip. *C. gallii* also has usually some antero-posterior flattening. It may be a smoother, but is often a rougher, pupa than that of *H. euphorbiae*. All these characters vary very much so that a mixture of pupæ is difficult to separate again. The only one, so far as my observation goes, that can be relied on, is the presence in *C. gallii* of the same prespiracular sculpturing on abdominal segment 6, as on 5. The colouring varies similarly, but the pupa of *C. gallii* has a ruddy tint, rarely seen in that of *H. euphorbiae* (Chapman). Length $1\frac{5}{8}$in., including the short, curved horn or anal spike, and moderately stout; the head rounded and narrower than the thorax, the anal extremity a little tapered, but otherwise tolerably uniform in bulk; the wing-cases were close to the body, and extended as far as the fourth abdominal segment; the last five segments were rather deeply cut and flexible, the sides of the incisions smooth, all the other surface granulous. Ground colour deep red, much suffused or sprinkled with black, especially on the wing-, antenna- and trunk-cases, also on the back of the thorax; this last had, however, a dorsal line, and the pieces of the thorax were outlined with the ground colour; the antenna-cases and the ends of the wing-cases were relieved by a fine marginal streak of flesh-colour; the smooth sides of the abdominal incisions were deep and rather purplish-red; the spiracles blackish-brown (Buckler, October 12th, 1870).

Foodplants.—*Galium verum* flowers, unripe seeds and leaves (Buckler), *Galium mollugo* (Schmidt), *Galium saxatile*, prefers scrubby plants (larvæ refused *Galium palustre* and *G. aparine*, and some Scotch larvæ refused *G. mollugo*) (Syme), *Fuchsia* (Sich), *Clarkia* (Barnes), *Rubia tinctorum*, *Epilobium palustre*, *E. hirsutum* (Berce), *Epilobium angustifolium* (Collins), *Galium sylvaticum*, *Epilobium palustre*, *Impatiens noli-me-tangere*, *Asperula*, *Tithymalus*, *Escallonia* (Bartel), *Vitis vinifera* (Chaumette). Bartel says: "Lives on *Epilobium angustifolium* in Labrador; the larvæ living on *Tithymalus* are mostly olive-green." Constant, Peyerimhoff and Macker also note *C. gallii* larvæ as feeding on *Euphorbia* (= *Tithymalus*).

Parasites.—*Trogus exaltatorius*, Panz. (Bloomfield), *Amblyteles proteus*, Christ (Bloomfield). In the Lena district the larvæ were in abundance but mostly stung (Herz). Tugwell notes that not one of the many larvæ he obtained in 1888 was attacked by any parasite. In *Zool.*, p. 6031, is an account of the destruction of ichneumon eggs on a larva, taken October, 1857, at Deal. The eggs were whitish in colour, attached to the skin, were destroyed by means of a darning-needle, when the larva pupated in due course and produced an imago in mid-January, 1858, after being forced from mid-December (Syme).

Habits.—The species owes its position in the British list to immigration. For many years no example will be taken, and then a sudden influx of imagines in July or August is followed by a great abundance of larvæ in August and September. This periodical appearance is common to the more northern and western limits of its range. Thus, we find the species reported as very common at Prague in 1789 (Preyssler), as very abundant in 1856

at Nantes; Graeser notes the larvæ as very abundant at Behrenfeld in 1870; usually rare in Thuringia, but in some years the larvæ are abundant; in 1875 the larvæ were in thousands in the Dresden district; usually rare at Leipzig, but found everywhere in great numbers in 1888, also generally rare in Crefeld, but common in 1888; at Waldeck, uncertain, generally rare, in some years more abundant, particularly so in 1888, in which year, indeed, the species was recorded as being in unusual numbers throughout the whole of Central Europe; found at Kempten in 1894, although not noticed for 20 years previously; in the "forties" it was common in New Pomerania and the Anclam districts, but has been found only most sparingly ever since. The years of abundance in Britain have been 1859, 1870, 1888, and, in these years, it was also abundant in most parts of Europe in the same latitude as the British Isles. Grentzenberg notes larvæ as very abundant one year at Dantzig, Moeschler that in Upper Lusatia in some years it is not rare; Schmid that the larvæ are sometimes abundant at Ratisbon, Weiler that it is uncertain at Innsbruck, in some years common, Hering in some years common in Pomerania, Heinemann not rare in certain years in Brunswick, and Glitz that it is common in Hanover in certain years. It is difficult to account for this irregularity in the appearance of the species. Fairly abundant almost every year in certain warmer parts of the Alpine region of Europe, the species, without having been noticed to increase to any great extent in its usual haunts, appears, in the imaginal state and at irregular periods, to make inroads into territory from which it has been for many years absent, and strangely, as our "Times of Appearance" show, in different months of the year. The immigrating imagines lay eggs, larvæ are found in abundance and pupæ produced, but, owing to causes, probably climatic, of which we have little knowledge, the pupæ fail to develop their imagines, and the following year few or no imagines occur. The moth flies usually in the early evening, and is to be found at dusk at a variety of flowers. Bartel says that, in Germany, the imagines are attracted by those flowers which are especially loved by the Sphingids, more particularly *Petunia* and *Convolvulus arvensis*, whilst, in Roumania, *Petunia* and *Convolvulus tricolor* are given as the favourites by Caradja. Newly-arrived immigrants in this country have been taken at verbenas at Brighton (Griffith), and at the flowers of the same plant at Worthing (Wyatt), at Breadsall (Stowell), at Plympton (Purdue), and at Clevedon (Brackenridge); at jessamine at dusk, at Holloway (Stoneman); at honeysuckle, at Great Yarmouth (Paget), at 8.40 p.m., at Breadsall (Stowell), also at Warrington (Greening), at Oundle (Whall), at Wisbech (Glenny), at Anne's-on-Sea (Baxter), at Macclesfield (Goodall), at Darenth (Mercer), and at Halesowen, near Birmingham (Enock); at sweetwilliam flowers at Alford (Garfit), also at Carlisle (Goodfellow), and at Hayton, at 9.30 p.m. (Routledge); at petunias, at 6.30 p.m., in Gloucester (Hallett-Todd), also at Hopwood, near Birmingham (Landon), at Brighton (Taylor), at Beccles (Farr), at Leominster (Hutchinson), at Caerwood (Sellon), at Weston-super-Mare (Aldridge), and at Alphington (D'Orville); at rhododendrons at Rugeley (Bonney), at *Echium vulgare* at St. Margaret's Bay (Williams), at larkspur at Dartford (Youens), at white campion at St. Anne's-on-Sea (Baxter); at scarlet

geranium at St. Weonard's (Bond), at Buckhurst Hill (Tudor), and at Branscote (Watkins); at phlox at Stonehouse (Nash), at red valerian about 9.15 p.m., at Leckhampton (Trye), at carnations at Hackney (Wright), and over *Delphinium formosum* at 9.15 p.m. at Harrogate (Thompson). Mitchell notes the capture at Wolsingham, of a ♀ at 7.30 p.m., a ♂ at 8 p.m., a ♀ also at 8 p.m., and another ♀ at 10.30 p.m., while flying over a flower-bed, consisting of phlox, geranium, *Dianthus*, asters, *Lilium* and petunias. In 1843, at Sudbury, a specimen is recorded as having been caught by the tongue by a flower of *Œnothera spinosa*. Bang-Haas notes that it sometimes flies by day in Denmark in such years as it occurs there. Leech records it as hovering over flowers by the side of a mountain in the neighbourhood of Tsuruga, and, in Belgium, Lambillion says that it flies on sunny days over flowers like *Sesia stellatarum*, and Mengelbir notes the imago as revelling in the bright sunshine at St. Moritz. Doubleday captured one in the early morning, at Epping, hovering over flowers of *Argemone grandiflora*; and it was also noticed, at Oxton, flying at geraniums in the daytime (Studd), flying in the hot sunshine at Deal (Harding), flying in the hot sunshine about 2 p.m., and hovering round a woodland pool at Rivington, near Bolton (Calderbank), whilst a fine specimen was seen at 1 p.m. over petunias at Cambridge (Cumming), and another hovering over rest-harrow at 11 a.m., in bright sunshine, at St. Anne's-on-Sea (Baxter). This species is not very frequently recorded at light. Tetley, however, notes that imagines occurred at Taunton, in 1888, in some numbers, at electric light, nearly all being much damaged as they had got inside the large globes of the lamps; Farrant captured four thus (*Ent.*, xxiii., p. 100). Bloomfield heard of one taken at electric light at Hastings, in 1892; Burrows took one on a lamp at Snaresbrook station; Sheldon had one fly into his room at Kingsdown in 1888, as did Stainton at Lewisham, whilst Murray records one as flying into a forge at Lancaster. Examples have also been recorded as resting on an ash trunk in the Hawick district (Guthrie), on an apple-tree at Witham (Cansdale), on a poplar at Plymouth (Rowe), on a creeper at Birmingham (Landon), on the quay, at Hartlepool (Gardner), and in a greenhouse at Plumstead (Barns). The female moths, as we have already noted, live for a long time in confinement, three to four weeks if well fed, and they continue to develop eggs all the time, laying from 300—400 apiece, but if they are badly fed, or the weather is very hot, they lay from 40—50 eggs and die in about a week (Head).

Forcing pupæ.—In confinement very few British-reared pupæ go over the winter satisfactorily, and produce their imagines the following summer, as is usual with Continental-reared examples. The following have been recorded—July 6th, 1856, another a few days later, and a third August 6th, 1856, from larvæ obtained August, 1855, at Deal; another bred July, 1860, from larva found August, 1859, at Deal (Harding); May 25th, 1857, from larva found September, 1856, at Brighton (Griffiths), five bred in 1860 from larvæ found in 1859, near Perth (White), four bred in 1860 from larvæ obtained in the autumn of 1859, at Cockermouth (Robinson), July 8th, 1860, from larva obtained August 16th, 1859, at Rottingdean

(Image), July 9th, 1860, from larva found at Lytham in the autumn of 1859 (Gregson); August 1st, 1860, from a pupa obtained from larvæ taken August 16th-29th, 1859, another pupa being then alive (Batho); July 18th, 1862, from larva found September 24th, 1861, at South Shields (Eales), July 17th, 1871, from larvæ found September 18th, 1870, at Lewes (Jenner), two imagines in June, 1889, from larvæ taken at Ramsgate in September, 1888 (Buckmaster). Bloomfield notes (*E.M.M.*, xxv., p. 455) that Hele of Aldburgh had 20 pupæ from 1888 larvæ, that these were kept in sand covered with moss in a cool room, and with no forcing whatever, and that of these, 13 imagines emerged in June and July, 1889. Peek, of Swefling, had 14 pupæ kept in an aquarium on their original sand from the seashore covered with moss, and the only forcing was a tepid bath once a fortnight, or when they looked dry. These 14 pupæ produced 10 moths in the following June and July, two other pupæ being ichneumoned. Generally, however, the want of success by those who attempt to keep their pupæ over the winter is so marked that most lepidopterists prefer to force them, subjecting the pupæ, after they have rested normally for 2 or 3 months, to such conditions of moisture and atmosphere that they are tempted to emerge prematurely during the winter months, although it is remarkable that some pupæ resist this forcing treatment, whilst others respond most readily. Syme obtained imagines March 20th and 23rd, 1857, from 1856 pupæ, the latter being kept on damp moss exposed, from January 26th, to an average day temperature of 75° F. by placing in fender every day. Costick reared imagines January, 1860, from larvæ found in the autumn of 1859 at Eastbourne. Buckler was the first to record the rearing of forced examples from the 1870 larvæ. He began the forcing process on 4 pupæ a few days after Christmas, the first moth emerged January 18th, the second on the 19th, the third on the 22nd and the fourth on February 9th, 1871; Capper also reared more than a dozen from New Brighton larvæ, the earliest emerging February 8th, 1871, the others somewhat later. From 1888 larvæ, Elisha bred several imagines in March, 1889, the pupæ being forced at a temperature of 60° F.-70° F., the specimens emerging from 14 to 16 days after being placed in this heat and no pupæ lying over; Corbett forced his pupæ, obtained from larvæ September, 1888, the imagines emerging in November and December of the same year; Arkle forced 12 pupæ from larvæ found on the Cheshire sandhills from January 1st, 1889, and bred five imagines between February 10th and March 26th, the other pupæ dying. Newstead states that larvæ, found on the Wallasey sandhills from September 8th-10th, 1888, pupated from 15th-22nd, 17 pupæ being obtained, the pupæ were kept in a room at a temperature of 45° F. to 50° F., and remained there until January 1st, 1889, when they were removed to a temperature of from 50° F. to 55° F., and were slightly sprinkled with water for the first time; on the 23rd four pupæ were placed in a "Pine stove" in a temperature of 60° F. to 75° F.; on February 26th one imago emerged, the three other pupæ also disclosing imagines before March 2nd. The remaining pupæ were then placed in the "Pine stove" and similarly treated; the first imago emerged on March 26th, the last on March 31st; one pupa, however, resisted the forcing, lived on for some weeks, and was then placed in "spirit" to be preserved as

a specimen. The conditions under which they were reared are summarised as follows: *September 18th-October 21st.*—Larvæ. Outside all day, fully exposed to sun, but always taken in during rain and at night. *November* and *December.*—Pupæ. Indoors; day temperature 50° F., night 45° F. *January 1st-22nd.*—Day temperature 55° F., night 46° F. Once damped. *January 23rd* to time of emergence.—Day temperature 75° F., night 60° F. Kept constantly damped. Tugwell was probably the most successful collector of the species in 1888. He forced all his pupæ, and records (*Young Nat.*, x., p. 44) rearing 53 specimens between December 9th, 1888, and January 22nd, 1889, later emergences bringing the total up to 111 (*loc. cit.*, p. 145). His pupæ were exposed to an average temperature of 70° F., and were mostly out by April, when some, still remaining in the pupal stage at that date, were placed in a cool greenhouse, but from every living pupa an imago had emerged by July. He observes that it is really remarkable that, whilst the greater number of pupæ responded readily to the forcing treatment, others should resist it and emerge at the normal time of unforced specimens. In 1897, Benthall bred an imago on December 8th, 1897, from a larva obtained at Starcross on August 7th, 1897. Moss notes that, of four larvæ from the Wallasey and Waterloo coast, September 14th and 18th, 1897, one larva was preserved, the pupæ from the other three were forced from October 20th; from one of these, an imago, emerged on November 15th, one died on November 30th, and the last emerged December 19th, 1897.

Habitat.—In Britain, where the species is very uncertain in its appearance, sometimes not being seen for many years, and then occurring in hundreds in the larval stage in certain favoured localities, one finds that it prefers wind-swept sandhills to any other locality, and that those nearest the sea-coast in Kent, Essex, Cheshire, Devon, Durham, &c., are the most frequently chosen, although Cambridge is also a well-known locality. At Deal, one of these favoured spots, it not only frequents the sandhills, but the larvæ are to be found abundantly on every little patch of *Galium* growing on the shingle between Deal and Dover, and within reach of the sea spray. These localities are very similar to those of the more northern continental districts favoured by occasional visits from immigrants from more southern climes, *e.g.*, Snellen notes larvæ as abundant some years on *Galium* on the dunes of Holland; Paux states that the insect is accidental in the dept. du Nord, the larvæ being found (as with us) in August and September, at intervals of some years, yet always in the same localities, *e.g.*, the low "roads" of Wattignies and the dunes of Dunkirk, and the same is true in Belgium, although, in New Pomerania, where it is also sporadic in its appearance, it is said not to be specially partial to the coast. Syme observes (*E.M.M.*, ii., p. 6) that the insect is not only irregular, but very local—capricious, one would be apt to say. He states that, although search has been made for the larvæ all over the sandhills from Deal to Sandwich, he has never found it, except from the 1st battery southwards as far as the large sandhills extend, and from the sea westwards for 200 or 300 yards; in 1857, and in this year only, the larvæ were taken on the shingle from Kingsdown to the vicinity of the rifle-butts to the south of that village, a little more than three-

quarters of a mile. Tugwell notes that, in 1888, he found larvæ over a considerable area in the Deal district, and not at all confined to the sandhills and coast, but extending from St. Margaret's Bay on the southwest to Pegwell Bay on the north, and extending from the sea-line to places five or six miles inland. In Essex, Cole found larvæ on the higher land bordering the shore of Osey Island, in the Blackwater estuary. Bartel says that, in Germany, the larvæ prefer sunny slopes and openings in woods, although, on the continent, its permanent home seems to be along the lower mountains of the central Alpine chains and the various branches originating therein, *e.g.*, Schütze notes the species as rare in the plains of Saxon Upper Lusatia, but common in the mountains, Bruand observes that, in the dept. Doubs, the species is more abundant in the mountains than in the lower districts, whilst Alphéraky states that it occurs in the mountains of the Kouldja district from 3000ft.—9000ft. In France, Oberthür says the species is more or less eastern, becoming commoner in Germany, whilst Peyerimhoff notes it in Alsace as preferring warm sheltered spots in the high mountains. It appears to be almost absent from the Mediterranean district, the only record that we have, besides those from Sicily and southern Italy, being the capture of a fullgrown larva at Trieste on September, 6th, 1897, by Mathew.

SUMMARISED HISTORY OF THE SPECIES AS BRITISH.—Harris is said, by Stephens, Curtis and others, to have first noticed this species as British in the *Aurelian* in 1778, under the name of *euphorbiae*, a larva having been found by him at Barnscray, near Crayford, on marshy ground, about the middle of August, but his description of the larva, which died soon after capture, and was not the one he figured, certainly suggests none of the characteristics of either *euphorbiae* or *gallii*, and one suspects that it was neither. Donovan is also said by Dale and others to record it as British, under the name of *euphorbiae*, in the *Nat. Hist. of Brit. Insects*, iii., pp. 51-52, published in 1794, from an imago taken at Bath. and four larvæ taken in Devonshire by Curtis, but as Donovan says that the Bath specimen was in his own collection, and he figures *euphorbiae* excellently, in all its stages, from French examples, it is unreasonable to suppose that the Bath insect was anything but what Donovan says it was, and the larvæ are certainly as likely to have been *euphorbiae* as *gallii*. Haworth says (*Trans. Ent. Soc. Lond.*, 1807, p. 99) that he had a British specimen which he had mistaken for *euphorbiae*, until Montague informed him in a letter to his friend, the Rev. W. Vaughan, that "he had taken the larvæ of both *gallii* and *euphorbiae* in Devonshire and bred them." This specimen he figures (pl. iv) under the name of *gallii*, but it is an undoubted *euphorbiae*, with, however, certain abdominal spots resembling those of *Phryxus livornica*. Stephens observes (*Illustrations*, &c.) that he "saw a living specimen about 1816, which was taken in the beginning of June on some palings in the City Road, and a second was detected near the same spot a year or two back." He also refers to the larva Harris took, and adds that "the species has several times occurred in the West of England, and has been taken near Penzance, in Cornwall, and at Kingsbridge, Devon, by Dr. Leach." He figures (pl. xii., fig. 2) the true *C. gallii* very well, and gives a good description thereof, ap-

parently the first reliable figure published in Britain. Dale notes (*Young Nat.*, supp. p. 58) that "Tuther obtained a specimen in London on June 27th, 1812, which is still in the 'Dale' collection, Cole took one at Islington in 1825, and Garnons one at Colchester in 1830; whilst Lockey found one at Charmouth in 1831, and two were taken on August 6th at Norwich;" Doubleday also captured an example very early one morning in August, 1831, at Epping (*Ent. Mag.*, iii., p. 285). The year 1834 is the first *gallii* year of which we have any record; four imagines were taken in August (2nd, 9th and 29th), and five or six others seen at Great Yarmouth, whilst several larvæ were found later on *Galium verum* on the North and South denes (Paget, *Ent. Mag.*, ii., pp. 434-435); Bass also records an example as captured in mid-September, 1834 (*loc. cit.*, ii., p. 529), and Dale states (*Young Nat.*, supp. p. 58) that "three others were recorded from Milton, near Peterborough, and one at Longhurst, Somerset. In July, 1835, an example was taken at Coundon (Bree, *Ann. Mag. Nat. Hist.*, ix., p. 482), also one in the same month at Worcester, whilst a third was captured in the Isle of Wight, by Lees (Edmonds, *Ent. Mag.*, iii., p. 410); two more were taken in early September, 1835, at Cumwheaton, near Carlisle, by Heysham (*loc. cit.*, p. 409). No further record appears until September 15th, 1842, when a fine ♂ was captured at Whitefield, near Bury (Edleston, *Zool.*, 1843). Humphreys and Westwood, in 1843, note the species as having been recorded from Devonshire, Cornwall, Isle of Wight, London, Warwick, Worcester, Twizell, Cumwheaton, Cumberland, and Cramond, near Edinburgh. One is recorded as having been taken in June, 1846, at Lewes (Weir), another near Faversham (Horsley), and one on September 1st, 1846, at Rainham in Kent (Longley). None were recorded then until July 22nd, 1854, when a specimen was taken near St. Margaret's Bay (Thorne), and in 1855 a few larvæ were found in mid-August by Smith at Deal, whilst one other larva is recorded from Devonport on September 5th by Hayward. The later records, particularly those relating to the 1859, 1870 and 1888 immigrations, are dealt with in the paragraph on "Times of Appearance."

Time of appearance.—Usually in May and June, (more rarely in July) after hybernation as pupa; occasionally imagines are disclosed (without forcing) in August, September and October of the year in which pupation takes place, after a pupal period of only two to four weeks. Its appearance, however, is so irregular that one may often observe larvæ and imagines at the same time (Bartel). As bearing out this statement, Ochsenheimer (*Die Schmett.*, iv., p. 177) notes that Treitschke found 3 larvæ on the Schotenweiderich on July 2nd, 1816; these pupated, and one produced an imago after 17 days only, whilst the others emerged (♂ and ♀) after being exactly a year and 17 days in the pupal stage. Thurau notes (*Berl. Ent. Zeits.*, liv., pp. 19-20) that a few *C. gallii* pupæ produce imagines the same year, that he has observed that larvæ pupating before July 15th emerge after some two weeks, the others not till the next year. In Britain immigrant imagines generally appear in July or August, usually at a long interval of years. These lay eggs from which larvæ are obtained in August and September, the pupæ being usually forced in the winter, or allowed

to remain under shelter till the following spring, and it is very rarely, if ever, that any pupæ live throughout the winter, in nature, in the British Isles, and produce imagines at the normal time in the succeeding year, although a few do so in confinement (*anteà*, p. 191). The practical absence of records of specimens taken wild in 1836, 1860, 1871 and 1889, the years following those in which the species was abnormally abundant in Britain, is evidence of this. In its more southern haunts the species is, more or less, double-brooded, the imagines appearing in May-June, and in fewer numbers in August, but we suspect that the imagines that reach us belong rather to a late-emerging early than to the later brood. Of British-reared examples, Head states that a few autumnal imagines usually emerge after a pupal period of from three to four weeks. As we get further north the insect becomes apparently permanently single-brooded, appearing from late May to July, although, wherever immigrants appear, the more rapid-feeding progeny attempt to produce a partial second (or later if the immigrants themselves really belong to a second) brood. In Bukovina there are two broods (Hormuzaki); May, and again in July and August (July 7th-August 17th) in two generations, in Roumania (Caradja), May and June, and again in August, in Bohemia (Nickerl), May and June, and again in August and September, at Budapest and Eperies (*teste* Bartel). The following southern records suggest a second brood, *viz.*, July and August in Tuscany, September in Lombardy, commencement of September in Hermannstadt. Of partial double-broodedness we have the following—in Saxon Upper Lusatia in May and June, but every large brood produces also a few imagines in August (Schütze), some emerge in August at Munich only two weeks after pupation (Kranz), May and June, and again in August and September, at Baden (Reutti), in May and August at Mombach (Bartel), in June and August-September in Alsace (Macker); whilst larvæ in May, imagines in August and October at Schwerin, August in Debreczen, end of July at Noworossiisk on the Black Sea, also suggest double broods, and we also have to consider such records as May and June at Sarepta; June in the Altai district, June and July in the Kouldja district from 3000ft.—9000ft., whilst, in the far east, June is noticed for Fujisan (Pryer), and July at Tsuruga (Leech). May to July rare, is given for Eutin, May and June at Bremen, June and July at Crefeld and in the Netherlands, May to August at Elberfeld, May and June rare at Brunswick, &c., the whole of the latter German localities possibly being included in the immigration area of the species. Fritsch gives dates for Austro-Hungary from May 15th-July 19th, also possible second-brood emergences on August 27th and September 4th at Salzburg, and October 1st at Vienna. Frey notes the species as occurring in the early summer throughout Switzerland, but Nägeli took it at light at Zürich, on August 25th, 1895. Anderson observes that unforced pupæ, obtained in 1889, from Switzerland, produced imagines on July 10th, 1890, and following days, whilst Colignon records one as late as October 8th, 1898, at Namur. The following list of captures in Britain excludes records of examples bred in confinement, which will be found (*anteà*, pp. 191-193) under the head of "Forcing Pupæ," and also excludes the earliest dates, already mentioned under the head of "Summarised history of the species as British" (*anteà*, p. 194) September 15th, 1842, at Whitefield, near Bury (Edleston), Sep-

tember 1st, 1846, at Rainham (Longley), ♀ July 22nd, 1854, at 9.30 p.m., between Kingsdown and St. Margaret's Bay (Thorne), August 6th, 1856, at Cowfold (Borrer), August 16th, 1856, at Darenth, June, 1857, during the 1st week, at Rugeley (Bonney), August 27th, 1857, at Lewisham (Stainton), September 2nd, 1857, at Brighton (Image), another September 2nd, 1857, at Brighton (Griffith), September 2nd, 1857, at Stricklands, another on September 4th, 1857, at Stowmarket (Bree), September 10th, 1857, at Kingston-on-Thames (Sheppard), second week in August, 1858, at Worthing (Wyatt), Birkdale Park in August (Hudson), September, 1858, at Southport (Gregson), September 3rd, 1858, ♀ at Brighton (Winter), October 13th, 1858, at Liverpool (Galliers), July 3rd, 1859, at Macclesfield (Goodall), July 3rd-20th, 1859, at Deal (Harding), July 4th, 1859, at Hackney (Wright), July 4th, 1859, at Darlington (Orde), July 4th, 1859, at Leckhampton (Trye), July 5th, 1859, at Gainsborough (Tearle), July 5th, 1859, at Bungay (Garneys), about July 14th, 1859, at Tunbridge Wells (Challis), July 17th, 1859, at Oundle (Whall), July 18th, 1859, five at rest at Reach, near Cambridge (Farren), July 26th, 1859, at Cambridge (Cumming), July 26th, 1859, at Clevedon (Brackenridge), August 9th, 1859, at Lulworth (*teste* Dale), between August 10th and 30th, 1859, at Beccles (Farr), August 11th, 1859, at Brighton (Taylor), August 29th, 1859, at Gillingham (Chaney), 1st week in September, 1859, an imago at Cheshunt (Boyd), seven imagines, October, 1860, at Worthing (Rickman), July 13th, 1865, at Folkestone (Meek), June 20th, 1866, at Mansfield (Daws), one specimen at Deal, in 1868 (Harding), one at Malvern in 1870 (Towndrow *teste* Rea), in 1870 at Plymouth (Rowe), at Middlesborough and Sheffield in 1870 (Rowntree), July 7th, 1870, at Leominster (Hutchinson), July 11th, 1870, at Exeter (Hellins), August, 1870, at Plumstead (Barns), August, 1870, at Cainscross, near Stroud (Braund), ♂ August 1st, a ♀ August 9th, August 12th a ♀, August 13th, 1870, a ♀, all at Wolsingham (Mitchell), two on August 1st, two more on August 6th, 1870, at Breadsall (Stowell), August 2nd, 1870, at Stonehouse (Bignell), August 2nd, 1870, at Birmingham (Landon), August 2nd, 1870, in Birmingham, August 3rd, 1870, at Halesowen, near Birmingham (Enock), August 3rd, 1870, a ♀ at St. Weonards (Bond), August 3rd, 1870, imago at Ipswich (Hunt), August 3rd-5th, 1870, at Stalybridge (Jolliffe), August 4th, 1870, at Great Glemham (Bloomfield), August 5th, 1870, at Alphington (D'Orville), August 5th, 1870, a specimen at Branscote (Watkins), August 5th, 1870, at Oxton (Studd), two imagines, one taken on August 5th, 1870, at Caerwood (Sellon), August 5th, 1870, at Rivington, near Bolton (Calderbank), August 7th, 1870, at Leominster (Hutchinson), August 7th, 1870, at Warrington (Greening), August 7th, 1870, at Kinghorn (Syme), August 9th, 1870, at Stamford Hill (Moore), August 10th, 1870, in Gloucester (Hallett-Todd), August 11th, 1870, three examples at Bowhill (Mathison), August 12th, 1870, at Tooting (Hast), August 13th, 1870, at Weston-super-Mare (Aldridge), August 17th, 1870, at Winslow (Mathison), a fine example about the middle of August at Plymouth (Rowe), about August 18th, 1870, three seen, one caught at Kilmarnock (Robinson), August 24th, 1870,

at Lewes (Jenner), August 26th, 1870, at Wendron (Daws), August 26th, 1870, at Helston (Anstay), August 29th, 1870, at Witham (Cansdale), August 10th, 1872, at Victoria Park, Hackney (Clark), two examples in August, 1875 (Milne), August 7th, 1875, at Norwood, near Norwich (Laddiman), [August 11th, 1876, at Lakenham (Stally *teste* Parker),] July 6th, 1888, at Harrogate (Thompson), July 16th, 1888, at Howth (Hart), July 17th, 1888, at Aberdeen (Horne), July 18th. 1888, at Hartlepool (Robson), July 19th, 1888, at Scarborough (Head), July 20th, 1888, at Kingsdown (Sheldon), July 20th, 1888, at Hartlepool (Robson), July 20th, 1888, at Stoke Newington (Quail), July 21st, 1888, at Hayton (Routledge), July 21st, 1888, at Hest Bank, near Morecambe (Chappell), July 21st, 1888, two, near Derby (Bindley), July 21st, 1888, at Carlisle (Goodfellow), July 22nd. 1888, at Fleetwood (R. A. Clarke), July 22nd. 1888, at Bradford (Carter), July 22nd, 1888, at Edinburgh (Evans), July 22nd, 1888, at Holloway (James), July 22nd, 1888, at Stockbridge (Cockburn), July 23rd, 1888, at Silvertown (Graham), July 23rd, 1888, at Eton (Blair), July 23rd, 1888, at Stony Stratford (Thompson), July 23rd, 1888, at Upper Holloway (Stoneman), July 24th-August 4th, 1888, seventeen imagines at St. Margaret's Bay (Williams), July 24th, 1888, at Kingsdown (Sheldon), July 24th, 1888, at Hartlepool (Gardner), July 26th, 1888, at Harrogate (Thompson), July 27th and 28th, 1888, at St. Anne's-on-Sea (Baxter). July 29th, 1888, at Folkestone (Austen), July 30th, 1888, on coast of Kintyre (Christy), August 2nd, 1888, at Buckhurst Hill (Tudor), August 2nd, 1888, at Alford (Garfit), August 4th, 1888, at Dartford (Youens), August 4th, 1888, about two miles from Dundee (Kirk), August 4th, 1888, at Gravesend (Gostling), one, in Glasgow exhibition, August, 1888 (Henderson), August 19th-20th, 1888, at Hartlepool (Robson), August 12th, 1889, a ♂ at Sowerby Bridge (Copley), August 12th, 1890, at Clapton (Simes), July 13th, 1892, at Hartlepool (Gardner), August, 1892, at Paul (Daws), one towards end of August, 1900, at Stonehouse (Nash).

LOCALITIES.—ABERDEEN: Aberdeen (Horne). ARGYLL: coast of Kintyre (Christy), Isle of Jura (Campbell). AYR: Monkton (Duncan), Troon (Smith), Kilmarnock (Stewart). BERKS: Reading (Poulton). BUCKS: [Aylesbury (*E. W. Int.*, ii., p. 277], Winslow (Mathison), Stony Stratford (Thompson), Eton (Blair). CAMBRIDGE: rare, Ely, Chatteris (Balding), Fulbourn (Crallan), Reach, near Cambridge, Gogmagog Hills (Farren), Cambridge (Cumming), Newmarket (Verrall), Wisbech (Glenny). CARNARVON: Abersoch (Day). CHESHIRE: only from the coast sandhills (Ellis), Wallasey (Greasley), Stalybridge (Jolliffe), Macclesfield (Goodall), Crosby sandhills (Newstead). CORNWALL: near Penzance (Leach), Wendron, Paul (Daws). CUMBERLAND: Cockermouth (Robinson), Carlisle district (Armstong), Workington (Mawson), Hayton (Routledge), near Brampton, Maryport (F. H. Day). shores of the Solway Firth (Robinson), Carlisle (Goodfellow), Cumwheaton, near Carlisle (Heysham). DERBY: Breadsall (Stowell), near Derby (Bindley). DEVON: Oxton, once (Studd), Plymouth (Rowe), Plympton (Purdue), Exeter (Hellins), Alphington, Kingsbridge (D'Orville), Ilfracombe (Mathew), Devonport (Hayward), Starcross (Benthall). DORSET: Charmouth (Lockey), Lulworth (*teste* Dale). DUBLIN: Dublin coast (Coulter), Howth (Hart). DUMFRIES: shores of the Solway Firth (Robinson). DURHAM: on the coast (Robson), South Shields (Hamilton), Hartlepool (Gardner), Wolsingham (Mitchell), Darlington (Orde). EDINBURGH: Edinburgh (Evans), Cramond, near Edinburgh (Duncan), Stockbridge (Cockburn). ESSEX: coast districts (Harwood), Buckhurst Hill (Tudor), Epping (Doubleday), Felixstowe (Stainton), Colchester (Garnons *teste* Dale), Shoeburyness (Sheldon), Witham (Cansdale), Southend (Nicholls *teste* Vaughan), Osey Island (Fitch), Silvertown (Webb). FIFE: between

Glassmount and Kinghorn Loch (Syme). FORFAR: Dundee (Kirk). GLOUCESTER: Bristol district, throughout, but scarce, near Gloucester (Hudd), Redlaud (Mayes *teste* Harding), Durdham Downs (Greene), Cainscross, near Stroud (Braund), Gloucester, Aldsworth (Hallett-Todd), Stonehouse (Bignell). HANTS: Isle of Wight (Duncan), Freshwater (Rogers), Lymington (*teste* Kaye). HEREFORD: Leominster (Hutchiuson), St. Weonards, near Ross (Bond). HERTFORD: Cheshunt (Boyd), Snaresbrook (Burrows). ISLE OF MAN: Douglas (Gregson *teste* Clarke). KENT: Kingsdown (Sheldon), Dover (Rogers), Darenth (Mercer), Plumstead (Barns), Maidstone (Foster), Gravesend (Gostling), Charlton (Potter), Tunbridge Wells (Challis), Lewisham (Stainton), The Warren, Folkestoue (*teste* Knaggs), Faversham (Horsley), Rainham (Longley). Folkestone (Meek), Walmer, Deal, St. Margaret's Bay (Tutt), Gillingham (Chaney), Sheerness (Fletcher), ? Swanley (Milton), Ramsgate (Buckmaster), Dartford (Youens). KIRKCUDBRIGHT: Cobend (White). LANARK: Glasgow, one (Eggleton). LANCASHIRE: Risley Moss (Collins), Whitefield, near Bury (Edleston), Rivington, near Bolton (Calderbank), Morecambe Bay, Carnforth Marsh, Lancaster (Murray), Southport (Davis), Bootle (Gregson), Liverpool (Galliers), Lytham, St. Anue's-on-Sea (Baxter), Bolton, Middleton, Blackpool, Hest Bank, near Morecambe (Chappell), Warrington (Greening), Waterloo (Moss), Fleetwood (Clarke). LEICESTER: Loughborough (Wieldt), Gumley (Matthews). LINCOLN: Gainsborough (Tearle), Alford (Garfit). MIDDLESEX: Stamford Hill (Moore), Islington (Cole), Edmonton (Jobson), Hackney (Harding), Holloway (James), Kilburn (Wormald), Chiswick, one (Sich), Clapton (Simes), Stoke Newington (Quail). MONMOUTH: Caerwood, near Chepstow (Sellon). NORFOLK: [Lakenham, Norwich (Parker),] Yarmouth, (Paget), Gillingham (Barrett), Helston (Anstay), Cromer (Tawell), Norwood, near Norwich (Laddiman). NORTHAMPTON: Thurning, near Ouudle (Whall), Milton, near Peterborough (*teste* Dale). NORTHUMBERLAND: on the coast (Robson), Newcastle-on-Tyne (Hamilton), Twizel (Selby), Embleton (Embleton). NOTTINGHAM: Mansfield, two (Daws), Branscote, near Nottingham (Watkins), Nottingham (Smith). OXFORD: Henley (Stubbs). PEEBLES: Innerleithen (Haggart), Bowhill, near Selkirk (Mathison). PERTH: Earn and Perth districts, Auchtermuchty (F. B. White), Craigie (Lamb), Stanley-by-Perth (Marshall). ROXBURGH: Galashiels (Haggart), Hawick district—Wellogate, one (Guthrie). SOMERSET: Clevedon (Brackenridge), Weston-super-Mare (Aldridge), Bridgwater (Baker), Langport (Dale), Loughurst (*teste* Dale), Tauntou (Crotch), Eastover Bridgwater (Sanders). STAFFORD: Leckhampton (Trye), Rugeley (Bonney). SUFFOLK: Ipswich (Hunt), Felixstowe (Hensaw), Stricklands, Stowmarket (Bree), Beccles (Farr), Great Glemham, Tuddenham (Bloomfield), Aldeburgh (Hele), Highaın, Barton Mills, pleutiful 1859 (Brown), Bungay (Garneys). SURREY: Tooting (Hast), Weybridge (Milne), Kingston-on-Thames (Sheppard). SUSSEX: Lewes, Guestling (Jenner), Brighton (Griffith), Eastbourne (Costick), Worthing (Wyatt), Shoreham (Rickman), Cowfold (Borrer), Hastings (Bloomfield), Rottingdean (Image). WARWICK: Halesowen, near Birmingham, Edgbaston (Enock), Birmingham, Hopwood (Landon), Warwick (Duncan). WILTS: Amesbury (Batho). WORCESTER: Malvern (Towndrow *teste* Rea), Worcester (Richards). YORKS: Bishops Wood (Grassham), Bradford, Cleckheaton, Wibsey (Carter), Huddersfield, several (Inchbald), Hull (Young), Scarborough, three (Wilkinson), Sheffield (Doncaster), Spurn, a larva in 1877 (Lawton), Wakefield (Talbot), York (Stainton's *Manual*), Harrogate (Thompson), Middlesborough, Sheffield (Rowntree), Sowerby Bridge (Copley).

DISTRIBUTION.—Distributed almost throughout the Palæarctic and Nearctic regions—rare in western Europe, and absent in the extreme north, extending to the Caucasus, through southern Siberia and the Amur district iuto Japan, and thence through North America to the Atlantic. It occurs up to a moderate elevation, 5000 or 6000ft.. in the central European Alps, in the Kouldja mts. to 9000ft., and in Kashmir to 6000ft. AFRICA: Canary Islands (Speyer). AMERICA: Labrador (Kirby), Canada, United States (Fernald). ASIA: Japan—Fujisan (Pryer), Tsuruga (Leech), Altai (Speyer), Cilicia—Amasia, Tokat, rare (Lederer), Kouldja district, mountains between 3000ft. and 9000ft. (Alphéraky), Amurland, very rare—Nikolajewsk, Chabarowka, Pokrofka, Western Siberia, northern Central Asia (Staudinger), northeast Siberia: Lena district, abundant (Herz), Tobolsk, Uralsk and Turgai districts, southwest Siberia, Turkestan, Akmolinsk province, Semirjetschensk—Lepsa, Semipalatinsk—Saisan, Altai—between Ust-Kamenogorsk and Ust-Buchtarminskaja, in the Upper Irtish, Tomsk, Jenisseisk, Irkutsk and Jakutsk districts, Trans-Baikal province—Kentei mts., Primorsk (Staudinger and *teste* Bartel),

India—Gurais Valley, Kashmir (Hampson). AUSTRO-HUNGARY: Innsbruck, some years abundant (Weiler), Tyrol, rare, Botzen, Sarn-Thal (Hinterwaldner), near Vienna—on the Schotenweiderich (Treitschke), Bukovina, distributed and not rare (Hormuzaki), Pressburg (Rozsay), Bohemia, never common—Carlsbad (Nickerl), Buda, rare (Speyer), Neu Saudec (Klemensiewicz), Stanislawow (Werchratski), Galicia—Lemberg, frequent, Sambor, not rare (Nowicki), Brünn (Schneider), Agram, Biala, Budweis, Kaschau, Kremsier, Linz, Troppau (Fritsch), Hungary—Kocsocz (Vángel), Hermannstadt (Czekelius), Epiries, not common (Husz), Gölnitz (Hudák), Upper Carinthia—Salzburg, Moellthal (Nickerl), Lavautthal, rare—Lattenberg (Höfner), Upper Styria—St. Lambrecht (Kodermann), Upper Austria, rare—Traunreise, Mulkreise (Himsl), Moravia—Mährisch-Trübau, rare, Hungary—Transsylvania, Gyeke, St. Gotthard, Meszö-Zah, Noság, Rahó, Comitat Máramaros, Igló, Schemnitz, Tavarnok, Nagy-Lévard, Oedenburg, F.-Lövö, Fünfkirchen, Szegedin, Grosswardein, Erlau, Debreczen, Heveser Comitat, Budapest (*teste* Bartel), Trieste (Mathew). BELGIUM: generally rare (Donckier), Namur, Dinant, Liège, Charleroi (Lambillion). DENMARK: pretty general, especially in dry places (Bang-Haas). FRANCE: almost confined to north and northeast France (Oberthür), Aube — one, Riceys (Jourdheuille), Douai, one only (Foucart), Berry and Auvergne — Issoudun, very rare (Sand), Jura (Berce), Paris, Meuse, Moselle and Meurthe districts (Speyer), Morbihan very rare (Griffith, probably an error, Oberthür), Dept. du Nord — Wattignies, Dunkerque (Paux), Gironde, Bègles, very rare (Trimoulet), Doubs—Besançon, rare, more frequent in mountains, *e.g.*, Mont d'Or, Larmont, near Pontarlier (Bruand), Aude, rather rare (Mabille), Loire-Inférieure—Ancenis, very rare, Nantes (Bonjour), Saône-et-Loire—Chalon-sur-Saône (Constant), St. Quentin (Dubus), Deux-Sèvres (Maillard), Puy-de-Dôme—Mont Doré (Guillemot). FINLAND: South Finland—Osterbötten (Lampa). GERMANY: not rare (Heinemann), northwest Germany — distributed (Jordan), southwest Germany—Rheingau, Offenbach (Koch), Rhine Palatinate (Bertram), Wurtemberg (Seyffler), Giessen, very rare (Dickore), Lower Elbe district—Boberg, &c. (Zimmermann), Alsace and Lorraine (Berce), Waldeck, generally rare, common in September, 1836 (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle—Nietleben (Stange), Munich, rare, near Höhenkirchen, Pullach (Kranz), Lower Elbe district—Bahrenfeld (Graeser), Rudolstadt, not common (Meurer), Meckleuburg common (Schmidt), Bremen, rather rare—Hemelingen, near Gröpeling, &c. (Rehberg), Saxon Upper Lusatia (Schütze), Dresden, not rare (Steinert), Thuringia, distributed, but rare — Gotha, Arnstadt (Krieghoff), Prussia—everywhere, not rare (Grentzeuberg), Silesia, almost everywhere (Assmann), Upper Lusatia, distributed, some years not rare (Moeschler), Nassau, Wiesbaden, Frankfort, rather rare (Rössler), Ratisbon (Schmid), Oberharz, Sarnthal (Speyer), Pomerania (Hering), Dessau, not common (Richter), Wernigerode—Eichberg (Fischer), Brunswick (Heinemann), Hanover (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Chemnitz (Pabst), Schwerin, Holstein, Rendsburg, Delmenhorst, Crefeld, Mundelheimer Damm, Willicher, Bahndamm, Wildeshausen, Barmen, Elberfeld, Hilden, Ahrthal, Wetterau, Cassel, Leipzig, Schleissheim, Kempten, Mombach, Grünberg—Oberhessen, Saynbach, the Bavarian Palatinate (*teste* Bartel), Baden — Constance, Carlsruhe (Reutti), Alsace, not common, more abundant in the Bas-Rhin, Colmar, Zabern, Mundolsheim, Mülhausen, Doller, Basle to La Klybeck (Macker), Hildesheim, rare (Grote), Berlin district, not rare (Pfützner), Heligolaud (Gätke). ITALY: throughout, except Sardinia and Corsica, but not common (Curò), Sicily (Minà-Palumbo), Roman Campagna—Pisa, rare, Terra d'Otranto (Calberla), Modena (Fiori), Lombardy, Piedmont, Calabria (*teste* Bartel). NETHERLANDS: Holland, Zeeland, Friesland, Drenthe, Gelderland—Limburg (Snellen), Breda (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: singly—Grumazesti, Kloster Neamtz, Costischa, Comanesti, Jansy, Dobrudscha (Caradja). RUSSIA: Baltic provinces—Esthonia, Livonia: Dorpat, Neu-Kasseritz, near Werro, Kurland (Nolcken), Moscow govt. (Albrecht), Volga district—Kasan, frequent, Simbirsk, Ufa, Ural province, less frequent, Orenburg, Saratov, Sarepta, Samara, Astrachau, &c. (Eversmann), Transcaucasia, rare—Borjom, one (Romanoff), St. Petersburg (Erschoff), Archangel district, Oblonez on Lake Ladoga, Kiev district, Pskow district, Poland—Kamenez-Poloskii, Bessarabia, Cherson, Poltawa, Orel, Kaluga, Tambow district, Noworossiisk. SCANDINAVIA: not rare (Aurivillius), Scania, Blekinge, West Gothland, west and north Bothnia, Stockholm (Wallengren), Gudbrandsdal (Schöyen), Nörbotten (Lampa), Arctic regions—Labrador (Petersen *teste* Moeschler), Norway—south and central districts—Sydvaranger (Lampa), Christiania, Odalen, &c. (Siebke). SWITZERLAND: Probably in all the Swiss lowlands, but mostly rare, goes into the

mountains and reaches 5500ft. at Davos (Riggenbach), and at St. Moritz (Mengelbir), Canton Vaud, rare — Lausanne (Chaumette), Zürich (Nägeli), Tarasp, Davos (Killias), near St. Gallen, very rare, commoner, near Rorschach (Täschler), Gais (Peyerimhoff), Winterthür (Huguenin), Zurich, near Wipkingen, Bremi, in Seefeld, Wolfensberger, very rare (Frey), Bremgarten, rare (Boll), Basle district—Läufelfingen, Aargau, Solthurn Juras, near Lucerne (Wullschlegel), Burgdorf (Meisner), Berne, Gadmenthal (Rätzer), Neuenstadt (Couleru), Vevey (Wullschlegel), Valais—Leuk, at foot of the Gemmi (Meisner), Grisons—Chur, Bergell (Killias).

Genus: Hyles, Hübner.

Synonymy.—Genus: *Hyles*, Hb., "Verz.," p. 137 (*circ.* 1822); Stphs., "List Br. An. Br. Mus.," p. 28 (1850); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 492 (1758); xiith ed., p. 802 (1767); "Fauna Suec.," 2nd ed., p. 287 (1761); "Mus. Ludov. Ulric.," p. 356 (1764); Poda, "Ins. Mus. Græc.," p. 81 (1761); Scop., "Ent. Carn.," p. 186 (1763); Müll., "Faun. Frid.," p. 37 (1764); "Zool. Dan. Prod.," p. 116 (1776); Drury, "Ill. Exot. Ent.," i., pl. xxix., fig. 3 (1773); Hfn., "Berl. Mag.," ii., p. 180 (1766); Rott., "Naturf.," vii., p. 105 (1775); "Fab., "Syst. Ent.," p. 541 (1775); "Spec. Ins.," ii., p. 146 (1781); "Mant.," ii., p. 95 (1787); "Ent. Syst.," iii., pt. i., p. 367 (1793); "Syst. Gloss." in Ill.'s Mag., vi., p. 287 (1807); [Schiff.,] "Schmett. Wien," p. 42 (1775); n. Ausg., p. 12 (1801); Esp., "Schmett. Eur.," ii., p. 100, pl. xi., figs. 1-4 (1779); Bergs., "Sphing. Larv.," p. 7 (1782); Geoff., "Fourc. Ent. Paris.," ii., p. 254 (1785); Bork., "Sys. Besch.," ii., pp. 77, 139, 178 (1789); Brahm, "Insectenkal.," ii., p. 428 (1791); Don., "Brit. Ins.," iii., p. 51, pl. xci-xcii (1795); Hb., "Eur. Schmett.," ii., fig. 66 (1796); "Larv. Lep.," ii., Sph. iii., Legit. B. d. fig. 1a (*circ.* 1800); text p. 97 (*circ.* 1805); Cuv., "Tabl. Elem.," p. 592 (?1797); Schrk., "Faun. Boica," ii., pt. 1, p. 226 (1801); Haw., "Lep. Brit.," i., p. 61 (1803); "Trans. Ent. Soc. Lond.," pt. 1, p. 99, pl. iv (1812); Latr., "Hist. Nat.," xiv., p. 131 (1805); "Gen. Crust.," iv., p. 210 (1809); "Consid. Gen.," p. 440 (1810); Ochs., "Die Schmett.," ii., p. 223 (1808); Shaw & Nodder, "Viv. Nat.," xxi., pl. 922 (1810); Leach, "Edinb. Encycl.," ix., p. 131 (1815); Dalm., "Vet. Ak. Handl.," xxxvii., p. 214 (1816); Lam., "Hist. Nat. An.," iv., p. 11 (1817); Sam., "Ent. Compend.," p. 244 (1819); Godt., "Hist. Nat.," iii., p. 33 (1822); Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); Meig., "Eur. Schmett.," ii., p. 138 (1830); Evers., "Faun. Volg.-Ural.," p. 111 (1844); H.-Sch., "Sys. Bearb.," ii., p. 88 (1846); Speyer, "Geog. Verb.," i., p. 318 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," i., p. 146 (1859); Bang-Haas, "Nat. Tids.," (3), ix., p. 401 (1874). *Spectrum*, Scop., "Introd. Hist. Nat.," p. 413 (1777). *Deilephila*, [Lasp.,] "Jena. Allg. Lit. Zeit.," iv., p. 109 (1809); Ochs., "Die Schmett.," iv., pp. 42-43 (1816); Hb., "Franck Cat.," p. 87 (1825); Curt., "Brit., Ent.," i., pl. iii (1823); Stphs., "Ill. Haust.," i., p. 124 (1828); "Cat. Br. Ins.," ii., p. 32 (1829); Bdv., "Icon. Chen.," pl. i., figs. 1-2 (*circ.* 1840); "Gen. et Ind. Meth.," p. 47 (1840); "Hist. Nat. Sphing.," p. 162 (1875); Newm. & Raddon, "Ent. Mag.," iii., pp. 369 *et seq.*, 535 *et seq.*, pl. viii-ix (1834); Dup., "Hist. Nat.," supp. ii., p. 158 (1835); "Icon. Chen.," pl. iv., fig. 1 (*circ.* 1835); "Cat. Méth.," p. 41 (1844); Dunc., "Brit. Moths," p. 149 (1836); Wood, "Ind. Ent.," p. 14 (1839); Humph. & Westd., "Brit. Moths," i., p. 16 (? 1841); Assm., "Schm. Schles.," ii., p. 34, figs. 37*a*—*d* (1845); Dbld., "List Brit. Lep.," p. 3 (1847); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 18 (1851); Walk., "List," viii., p. 165 (1856); Sta., "Man.," i., p. 92 (1857); Humph., "Gen. Brit. Moths," p. 9, pl. ii., figs. 3-4 (1860); Staud,, "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 37 (1871); ed. 3, p. 102 (1901); Wallgrn., "Skand. Het.," i., p. 38 (1863); Ramb., "Cat. Lép. And.," p. 130 (1866); Snell., "De Vlind.," p. 96 (1867); Berce, "Faun. Franç.," ii., p. 21 (1868); Nolck., "Lep. Fn. Estl.," i., p. 88 (1868); Newm., "Brit. Moths," p. 7 (1869); Mill., "Cat. Lép. Alp.-Mar.," p. 119 (1872); Cuní y Mart., "Cat. Lep. Barc.," p. 39 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 111 (1875); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 570 (1876); Kirby, "Eur. Butts. and Moths," p. 70, pl. xviii., figs. 1*a*—*b* (1879); "Cat.," p. 666 (1892); Frey, "Lep. Schweiz," p. 57 (1880); Auriv., "Sv. Vet. Hand.," xix., p. 138 (1882); "Nord. Fjär.," p. 46 (1889); Weism., "Stud. Theory of Descent," transl. p. 201 (1882); Buckl., "Larvæ," &c., ii., p. 30, pl. xxiii (1887); Minà-Pal., "Nat. Sicil.," vii., p. 134 (1888); Barr., "Brit. Lep.," ii., p. 36, pl. xlviii (1895); Meyr., "Handbook," &c., p. 297 (1895); Lucas, "Brit. Hawk-

Moths," p. 88 (1895); Tutt, "Brit. Moths," p. 27 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 79 (1899). *Celerio*, Oken, "Lehrb. Zool.," i., p. 761 (1815). *Dilephila*, Hmpsn., "Ind. Moths," i., p. 98 (1892); Kirby, "Handbook," &c., iv., p. 32 (1897).

This genus, as here restricted, is very closely allied to *Celerio*, Oken, and was founded by Hübner as a heterotypical genus for the species included in these and the allied genera. Hübner's original diagnosis reads (*Verz.*, p. 137) as follows:

The forewings on the costa with cloudy spots; the body at the sides adorned with black and white cube-shaped spots—*Hyles galii*, Schiff., *H. opheltes*, Cram., *H. zygophylli*, Ochs., *H. hippophaes*, Esp., *H. nicaea*, Prun., *H. euphorbiae*, Schiff.

Stephens, in his application of the Hübnerian names to the British species (*List of the Specimens of British Animals in the Collection of the Brit. Museum*, v., p. 28) notes *euphorbiae* and *gallii* as belonging to this genus, but it was not until the publication of vol. iii of this work (*anteà*, iii., p. 355) that *euphorbiae* was formally constituted the type. Kaye's diagnosis (*in litt.*) of the limited genus reads as follows:

Head closely set on shoulders, eyes not large (except in tropical races). Foretibiæ with spines weak and almost uniform size. Forewing with costa very slightly curved at base, straight to origin of nervure 7, then sharply curved to apex; hind margin evenly curved to termen (in exotic races, slightly excised immediately below apex) inner margin slightly curved upwards for half length of wing. Nervure 5 from considerably nearer 4 than 6; 9 given off from about three-fourths length of cell. Hindwing short, apex bluntly pointed in ♂, almost rounded in ♀. Costa evenly and boldly curved to apex. Inner margin evenly curved to nervure 3, strongly excurved to nervure 1*b* and straight to anal angle. Nervure 8 curved almost evenly from base; 5 nearer 6 than 4; 6, 7 from upper angle; 3 from very close to 4. Discocellular variable from flat to strongly S-curved. Forewing with a more or less well-defined fascia; very broad at inner margin, with a dark discoidal blotch which nearly always lies within the fascia—*Hyles* (type *euphorbiae*).

We have, of course, only one species, *euphorbiae*, in this genus, with a shadow of a claim to be considered British; this species appears to be no longer sedentary in the British Islands.

Hyles euphorbiæ, Linné.

Synonymy.—Species: *Euphorbiae*, Linn., "Syst. Nat.," xth ed., p. 492 (1758); xiith ed., p. 802 (1767); "Faun. Suec.," 2nd ed., p. 287 (1761), &c. *Esulae*, Hfn., "Berl. Mag.," ii., p. 180 (1766); Rott., "Naturf.," vii., p. 105 (1775) *Galii*, Haw., "Trans. Ent. Soc. Lond.," 1807, pt. 1, p. 99, pl. iv (1807). [Note.—This species has not been known, except in the works of Hufnagel and von Rottemburg, already quoted, by any other specific name from the time of Linné. The older British authors (*e.g.*, Haworth), confused it and *C. gallii*. All other references made under the generic synonymy *Hyles* (*anteà*, p. 201) are referable to *euphorbiae*.]

Original description *.—*Sphinx euphorbiae*, alis integris fuscis; vitta superioribus flava; inferioribus purpurascente. *Fn. Suec.*, 1356. Reaum., *Ins.*, i., t. 13, f. 4-7. Roes., *Ins.*, i., phal. i., t. 3. Frisch,

* Linné's description of this species is most unsatisfactory. His references are as follows: (1) Reaum., "Mem.," i., pl. xiii., figs. 4-7—These figures and Reaumur's excellent description refer solely to *H. euphorbiae*. (2) Roesel, "Ins.," i., phal. i., t. 3—These figures refer to *H. euphorbiae*. (3) Frisch, "Ins.," 2, t. 11, f. 7—This plate certainly refers to *H. euphorbiae*, and fig. 3, which is sometimes queried, is also the larva of *H. euphorbiae*; it has a double row of spots. De Geer, "Ins.," i., t. 8, f. 6-11—These figures refer to *C. gallii*. Uddm., "Diss.," 28, 57—Possibly *euphorbiae*. In the face of so unsatisfactory a description as that of Linné, and such a mixture of references, one can only suggest that *euphorbiae* should stand for the well-known "Wolfsmilch or *Euphorbia*" species.

Ins., 2, t. 11 De Geer, *Ins.*, i., t. 8, f. 6-11. Uddm., *Diss.*, 57. Habitat in *Euphorbia*, *Galio* (Linné, *Sys. Nat.*, xth. ed., p. 492). [In the xiith. ed., p. 802, "flava" is changed to "pallida" and "purpurascente" to "rubra," whilst Linné further adds: "Alæ superiores, basi angustatæ; puncto nigro, in medio disci, minimo; vitta longitudinalis ex tribus coadunata. Inferiores supra disco rubro, lineis nigris divisa."]

Imago.—70mm.—82mm. Thorax olive, with white lateral line from front to end of thorax, passing through base of antennæ and along edge of wings; abdomen olive, banded superiorly with black and white towards thorax, but with slender intersegmental white bands only towards anus; a broad unbroken longitudinal median band of ground-colour. Anterior wings olive, with the median area and outer margin pale ochreous-grey, leaving the ground-colour to form a wedge-shaped fascia from apex to inner margin, a basal patch, a discoidal patch and a small costal patch nearer apex, the three last-mentioned united by a narrow costal streak of ground-colour; basal patch of white scales, an inner marginal basal black patch just below; inner margin edged with a fringe of white scales; fringes of outer margin unicolorous with outer area of wing. Posterior wings red, with a black basal patch and somewhat narrow black submarginal band; anal area white; fringes white.

Sexual dimorphism.—The ♀ is decidedly larger than the ♂. This appears to be so at any rate in any set of specimens supposed to be of the same origin, but the individual variations are so great that one cannot with confidence say more than that it appears to be so. The antennæ appear to vary from 11mm. to 13mm. in the ♂, and from 10mm.—12mm. in the ♀s, but the average difference for specimens of equal size of each sex is nearer 1·5mm. than 1·0mm. The ♀ antenna looks very decidedly more slender basally than that of the ♂, and, therefore, more clubbed. This seems to be partly actually the case, more a result of the hair-pockets of the ♂ antenna giving it a more uniform appearance than it really possesses. The ♀ is more robust and carries the greater width for four or five abdominal segments, whilst that of the ♂ tapers almost from the base. The first tibial spur is longer in the ♂, 2·0mm. to 1·6mm. in the ♀; the comb is better developed, but not more than in proportion to the larger spur. The abdominal fan is very small, arising from the usual position, *viz.*, an offset of the ventral abdominal plate immediately below the first (second?) abdominal spiracle, it arises from a minute area, about ·3mm. long and ·07mm. wide, and is so small that one says at first view it contains perhaps two dozen hairs, actually it contains about 100, the hairs are yellow-brown and about 2mm. long, the pocket-like fold containing it extends down through the following segment and is well-developed (Chapman).

Gynandromorphism.—The only gynandromorph of which we can find any record is the following:

a. Left side ♂, right side ♀. Left wings smaller; the body perceptibly divided by a median line, the left side green, the right reddish; palpi and legs white; the abdomen female (Germar, *Ahr. Fn. Eur.*, fasc. 1, tab. xxvi; Rudolphi, p. 53; Burm., p. 340; Hagen, *S.E.Z.*, xxii., p. 271).

Variation.—The variation of this species is highly interesting and suggestive. Not only is there an abundance of minor aberrational

development everywhere, but the facility with which it appears to respond to its widely differing environments has led to the formation of a great number of striking local races which differ greatly from each other, and represent probably incipient species. The so-called minor aberrational variations both in tint and markings are such that a sort of polymorphism is in existence in many localities, few examples being precisely similar. The ordinary red tinted aberration occurring almost everywhere with the type is known as ab. *rubescens*, but in almost every locality forms occur which may be described as follows :

With the lighter areas of the forewings of a pale ochreous-grey=*euphorbiae* Linn.

With the lighter areas of the forewings of a pale ochreous-grey, but much suffused with black scales=ab. *suffusa*, n. ab.

With the lighter areas of the forewings tinged with reddish=ab. *rubescens*, Garb.

With the lighter areas of the forewings bright red=ab. (et var.) *grentzenbergi*, Staud.

With the lighter areas of the forewings bright red, but much suffused with black scales=ab. *rufomelana*, n. ab.

Stichel (*Insekten Börse*, 1903, p. 13) gives the following summary of aberrations he has noticed (no. 1 coming from Austrian-Silesia, nos. 2—7 from Bohemia):

1. Forewings and hindwings with uniform smoky ochre-yellow ground-colour, hindwings showing only a quite faint reddish tone.
2. The olive-coloured oblique band of forewings very narrow anteriorly, &c.
3. The distal costal-spot of forewings only quite faintly expressed.
4. This spot somewhat comma-shaped.
5. Ground-colour very dark, especially the distal part of forewings, numerous black scales observable between basal spot and oblique band on the inner margin. Hindwings dusted with blackish.
6. Forewings covered all over with blackish spots and strokes, especially strongly on costa and in distal area.
7. Black submarginal band of hindwings reduced to a narrow zigzag line.

A large red-tinted Italian race is known as var. *paralias*, whilst a smaller and intensely red, race from Capri is known as var. *grentzenbergi*. A very dark aberrational form is known as ab. *esulae*, whilst one, in which the red parts of normal *euphorbiae* become yellow, is known as ab. *lafitolii*. Bartel considers (*Pal. Gross-Schmett.*, ii., p. 82) that this insect is one of the most variable of the Phryxid species, and reiterates the opinion that it may be still in the process of evolution, and that the various forms may not for centuries become changed into species with fixed and constant characters. Treitschke observes (*Die Schmett.*, x., p. 131) that examples smaller than *Theretra porcellus* and others far surpassing *Phryxus livornica* in size are not at all rare. Oberthür notes that the Brittany examples are of small size and pale in colour, and that he has a specimen from Brest in which the normal rose-colour of the hindwings is, on one side, replaced by white. Bartel further adds that specimens from Sicily are larger and much darker than those from central Europe; the forewings dusted with blackish, the red of the hindwings much darker and the black band before the outermargin of the latter very broad. Examples from Greece are also, he says, characterised by their larger size, and sometimes reach a wing expanse of 87mm., thus surpassing those from all other parts of Europe. Galvagni notes a very dark example from the Statzer-Thal. By

Treitschke *(loc. cit.)* an aberration is described with exceedingly long antennæ, which probably only relates to a crippled specimen. Bartel further notes that Heyne has also shown him a specimen in which the antennæ are nearly double as long as normal. Ochsenheimer mentions *(loc. cit.*, iv., p. 181) a very interesting aberration whose ground colour on the forewings is much mixed with blackish atoms and has a stripe of like colour running obliquely from costa to the inner-margin, whilst the red central band of the hindwings is coloured dark brown in the outer half. This specimen, which was in Ochsenheimer's collection, might form, Bartel considers, a transition to the much disputed ab. *esulae*. A further aberration from the collection of Bornemann, of Magdeburg, is described (and figured) by Ribbe (*Iris*, ii., p. 186, t. 4, f. 4) as follows: "The specimen differs from typical *D. euphorbiae* principally in the very dark coloured outer margin of the forewings. Their light ground colour appears only in a narrow waved band, running from the apex to the middle of the inner margin and internally somewhat shading off into the dark costal colour, otherwise the forewings are dark; the black band of the hindwings extends as far as the outermargin; the underside is correspondingly coloured and marked to the upper, and darker than in normal *D. euphorbiae*; epaulettes internally white margined. The example was bred at Magdeburg." He further notes that there is also in the Museum für Naturkunde, Berlin, in the Maassen collection, a large specimen of *D. euphorbiae* with the forewings much darkened, which may likewise be regarded as a transition to ab. *esulae*. Rey observes (*Berl. Ent. Zeits.*, liv., pp. 19-20) that examples bred in the autumn from pupæ of the year are smaller and duller than usual, Himsl that an imago reared from a 19-day old pupa was paler than usual. Newman's figures (*Ent. Mag.*, iii., pl. viii and ix), and those of Curtis (*Brit. Ent.*, v., fo. 3), made from Devonshire examples, and supplied by Raddon, suggest that ab. *rubescens* was a common form among those formerly reared in Britain. Curtis notes *(loc. cit.)* that "the male has less black in the underwing than the female, and an aberration of the former sex has occurred with the fascia of the inferior wings of a dark rose colour instead of black." Stephens says (*Illus.*, i., p. 125) that "the colour of the wings varies much; in some specimens the rosy tint is remarkably vivid and powerful, in others, it is somewhat obscure; the marginal fascia on the posterior wings also varies; it is sometimes entire, at others deeply indented on each side, and occasionally very narrow or very broad." Scheffler of Carlsruhe has fed larvæ of *H. euphorbiae* on oak, and Ernst Heyne, who saw the imagines resulting from this experiment, says that three of the specimens were very pale in colour, whilst one example was distinguished by its very dark colour. Borkhausen notes (*Rhein. Mag.*, i., p. 317) that specimens taken after the hard winter of 1789 were very pale, as were also those of *Amorpha populi*, and, as he bred only white-grey *Hyloicus pinastri* that year from wild pupæ, he thinks the cause was climatic.

α. ab. *helioscopiae*, Selys-Longchamps, "Ann. Soc. Ent. Belg.," i., p. 40 (1857); Bartel, "Palæark. Gross-Schmett.," ii., p. 88 (1899). *Euphorbiae* ab., Staud., "Cat.," 3rd ed., p. 102 (1901).—M. de Selys donne cet nom à une variété élevée de chenille à Halloy par un de ses fils et qui se distingue du type par l'absence de bande noire antimarginale aux secondes ailes (Selys). Belgium: Halloy; France; Germany: Dusseldorf; Tuscany (Bartel).

This aberration differs from the type in the failure of the outer

marginal black transverse band of the hindwings. Boisduval notes (*Ann. Soc. Ent. Fr.*, 3rd ser., iv., p. cx) this form as being of occasional occurrence. Calberla records (*Iris*, iv., p, 141) one in the collection of Stefanelli at Florence. Bartel says that it is everywhere very rare with the type.

β. ab. *lafitolii*, Thierry-Mieg, "Le Nat.," xi., p. 181 (1889); Bartel, "Palæark. Gross-Schmett.," ii., p. 87 (1899); Staud., "Cat.," 3rd ed., p. 102 (1901). *Lafitchii*, Kirby, "Cat.," p. 666 (1892).—Tout ce qui est rouge chez *euphorbiae* est jaune dans cette remarquable aberration. Il m'en est éclos quelques individus, conjointement avec des exemplaires typiques, de chenilles recueillies au pied des Albères (Thierry-Mieg).

Bartel notes that this form occurs in both sexes, that all that is red in typical *H. euphorbiae* is yellow in this aberration. The original type was bred from a larva collected at the foot of Les Albères (French East-Pyrenees).

γ. ab. *rubescens*, Garb., "Sitzungsber. der Math.-Natur. Classe der kais. Akad. der Wissenschaften," ci., p. 917 (1892); Bartel, "Palæark. Gross-Schmett.," ii., p. 86 (1899). *Rubrescens*, Seebold, "Ann. Soc. Esp.," xxvii., p. 119 (1898). *Paralias*, Staud., "Cat.," 3rd ed., p. 102 (1901).—This form scarcely requires a diagnosis as it is sufficiently described by its name. It is the red form of the species which is found everywhere, more or less rarely, with the type. It is normal except that the specimens are suffused with reddish, the pale portions of the forewings being cherry-red, the colour especially well-developed on the marginal band; the outer margin of the central diagonal almost always without red, whilst the red of the hindwings and underside is usually more intense. The larva typical, except that the orange-red markings pass into a dark carmine red. This form is very abundant in a dry meadow on the banks of the Sukiel river between Bolechow and Bubnisczze, and is here almost the only one developed—some 90 per cent.—so that, in this restricted locality (and certainly in many others), it has become a variety, whilst in most localities this dark form of the larva only occurs singly. The larvæ feed only on *Euphorbia cyparissias* and refuse other *Euphorbia* species, larvæ from Lemberg dying on *E. peplus*. This renders Pallas' remarks interesting: "Aliquoties Majo in campestribus ad Volgam (et Samaram?) circa Euph. pilosam et floribus volatu suspensa interdiu (in Galicia never by day) larva ad Jaicum passim in eadem et alia minore euphorbia Inderskiensium montium. Frequens etiam in Dauriae euphorbiis. In epilobio Sibiriae copiose 1770. *Epilobium angustifolium* et *palustre*, idemque *Galium verum* depascitur Larva 1770. In Sibiriae Euphorbiis frequens larvaque sæpe intra mensem edit sphingem (with us only one generation); quum alibi nunquam nisi post hiemem vel intra duos (never with me). . . . . *S. euphorbiae* larva *Evonymo* nutrita, dedit Sphingem obsoletissimi coloris siue ullo rubore, griseam." Such a specimen is in the Vienna Museum, and forms a transition to *D. galii*. Pallas did not know reddish forms, although he observed the species so often. Our ab. *rubescens* has often been referred to the beautiful var. *paralias*, Nick., and distributed as such. Even Frey calls the reddish specimens from the Jura *paralias* instead of *rubescens*, but these two forms are, however, not identical, and exhibit important differences at first glance, much more easily observed than described, *e.g.*, var. *paralias*, is much larger; the dark portions of the forewings are more weakly developed; the large olive-brown spot under the middle of costa considerably larger and horizontally hexagonal; the pale portions suffused with red, whilst, for the particular characters of the hindwiugs and underside, reference should be made to the author's description. The character of the red is most important, being quite uniformly spread and including also the outer margin of the diagonal, the tint, too, is of a beautiful uniform rose-red [in *rubescens* it is cherry-red, of about the tint of "coccineus" (No. 58*a* in Müller's "Table of Colours," 1860), whilst that of *paralias* corresponds with that of "ruber" (No. 57*a*, l.c.),] and it appears as if the moth was artificially coloured with red dusting, and the marginal area is never darkened. In both forms the white lateral stripes on shoulder-covers and head are commonly suffused with reddish. The larvæ of var. *paralias* were collected on the shore of Lido, and are distinguished from those of the type and ab. *rubescens* by their dark colour. . . . . Specimens received from Staudinger as *paralias* were really only normal south European examples of large

size, with no red in them*. It follows from Nickerl's description that these were incorrectly named. . . . . The third red form of this species is *grentzenbergi*, described from the double-brooded Capri examples. We have one of Staudinger's original specimens, which is rather small, very dark, the red colour and dark markings most highly developed, and not to be confounded with other aberrations, and most resembles the ab. figured in Berge's *Schmetterlingsbuch* and *tithymali*, Bdv., from the Canaries, a form that is continuously-brooded, flies on the southern limits of the Palæarctic region, and has, doubtless, already become distinct. The ab. *rubescens* is widely distributed in Galicia—Lemberg, &c. It must not be supposed that all dark larvæ produce ab. *rubescens*; some very dark larvæ from Okopy produced quite normal examples without exception (Garbowski). DISTRIBUTION.—AUSTRO-HUNGARY: Galicia—Lemberg, Hungary—Epiries, Bukovina, everywhere (Hormuzaki). FRANCE: Haute-Garonne, commoner than the typical form (Caradja). GERMANY: Berlin, Carlsruhe, Alsace (Reutti), Stuttgart (Seyffler), Thuringia (Knapp). ROUMANIA: transitional forms, rare. SWITZERLAND: with the type (Tutt).

ε. var. *paralias*, Nick., "Bohmens Tagfalter," p. 22, pl. i., fig. 2 (1837); Staud., "Cat.," 2nd ed., p. 37 (1871); 3rd ed., p. 102 (1901); "Hor. Soc. Ent. Ross.," xiv., p. 297 (1879); Garb., "Sitz. Akad. Wiss.," ci., p. 917 (1892); Kirby, "Cat.," p. 666 (1892); Bartel, "Pal. Gross-Schmett.," ii., p. 85 (1899).—Visiting the coast of Austrian-Italy in the summer of 1835, several larvæ were found on *Euphorbia paralias* on the Island of Lydo, near Venice. These were characterised by their large size and darker marking, when compared with the allied larvæ of *euphorbiae*. They were kept without food three days, and then only fed on half-dried plants, and so pupated rather earlier than might have possibly happened; the pupæ were sent to Prague, where imagines emerged the following April. Had they been better fed they would possibly have been still larger, but yet were about one-fifth larger than normal *euphorbiae*. They are similar to the latter in form and colour, but the large rhomboid spot in middle of costa of forewings in *euphorbiae*, is, in these, from 2 to 4 times larger and forms a horizontal hexagon in outline. In the pale colour red preponderates and the olive-coloured markings are brighter. On the hindwings, where a pale red tint also prevails, the black transverse band runs parallel to outer margin, shading on the inner side into olive-colour, and is much more strongly waved and forms at the anal angle a sharp triangle of olive colour, edged with black, with the point directed backwards, which is also larger and more acutely angulated than in *euphorbiae*. On the underside of the wings, red preponderates; the black spot of the forewings is considerably larger and the oblique simply-curved transverse band, passing from the costal margin of the hindwing backwards, which is often double in *euphorbiae*, is, in this variety, much more distinct, longer, S-shaped, curved from the front outwards, inwards and backwards. The olive-coloured spot at the anal angle is larger. This variety may be provisionally regarded as a new species under the name of *D. paralias* until someoue has compared the larva with that of the typical form of the species (Nickerl). DISTRIBUTION.—ASIA: northwest Asia Minor—Amasia, Tokat (Staudinger), Cilician Taurus, Syria (Staudinger). AUSTRO-HUNGARY: Budapest, Great Tapolezány. GERMANY: Elberfeld, Leipzig (Jordan), Erfurt, Baden—Freiburg, Lahr, Carlsruhe, Weinheim (Reutti). GREECE: Corfu, Parnassus, Attacus, Syra, Naxos (Staudinger). ITALY: Isle Lydo, near Venice (Nickerl), Porto d'Anzio, near Rome (Calberla), Sicily—Mondello (Curò). PORTUGAL (Bartel). FRANCE: Haute-Garonne (Caradja). RUSSIA: Transcaucasia—Borjom (Romanoff). [One suspects that many of these records belong to ab. *rubescens*, which occurs almost everywhere with the type, and not to the large Venetian race.]

Bartel notes (*Pal. Gross-Schmett.*, ii., p. 85) this variety as much larger than typical *H. euphorbiae*, as large as *H. nicaea*, but similar to the former in markings and colour, and points out particularly that the black spot in the middle of the forewings is much larger than in *H. euphorbiae*, and that the transverse stripe of the hindwings which, in *H. euphorbiae*, is simple or double, and arched, is, in var. *paralias*, far more sharply defined, longer, and bent in S-form, whilst the olive-coloured spot at the inner angle of the underside of the hindwings is larger

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* It is interesting to note that Staudinger, "Cat.," 3rd ed., p. 102, sinks Garbowski's *rubescens* as a transition form to *paralias*, Nick., but maintains his own *grentzenbergi*. One wonders whether Garbowski's criticism influenced Staudinger.

in this form. Bartel adds that it is only to be regarded as a large, light-coloured, sharply-marked form of *H. euphorbiae*, with a marked pale red tinge. He further points out that Staudinger's brief diagnosis "becoming red" has given rise to constant confusion between this and var. *grentzenbergi*. Galvagni notes (*Verh. Z. Z. zool.-bot. Ges.*, lii., p. 378) that an example was bred at Vienna, July 9th, from a larva taken at Pelagosa on June 7th. He also bred the same form from one found on *Euphorbia cyparissias* at Deutsch-Matrei (Tyrol), but the Pelagosa example differs from this one in having a darker wine-red marginal area of the forewings and deeper-coloured hindwings. The foodplant at Pelagosa may be *E. dendroides*, or *E. pinea*, which also occurs there. At Lussin, Garbowski found it on *E. wulfenii* (*cfr. Verhandlungen*, 1898, S.-B., p. 96). Calberla reports larvæ of var. *paralias* in great numbers on *Euphorbia paralias*, near Rome.

ε. var. *grentzenbergi*, Staud., "Ent. Nach.," xi., p. 10 (1885); Aust., "Le Nat.," viii., p. 259 (1886); Kirby, "Cat.," p. 666 (1892); Bart., "Pal. Gross-Schmett.," ii., p. 86 (1899); Staud., "Cat.," 3rd ed., p. 102 (1901).—Grentzenberg found, in May and June, 1884, in Capri Island, a quantity of larvæ of *D. euphorbiae* which differed little from normal German larvæ. Most of the larvæ had been stung by Tachinids, but he obtained some 30 sound pupæ. These pupæ (excepting 9, which are hybernating), in July, but mostly in September, produced moths so different from the ordinary German and other European specimens as to well deserve a varietal name, and I name them in honour of their discoverer. In all of them the light (grey or white) parts (especially of the forewings and the thorax) are more or less bright red in colour. This is especially striking in the broad medial and terminal bands of the forewings, which are always red, even though in one specimen the usual grey colour is here only covered over strongly with red. To be sure, specimens of *euphorbiae* with a red tint occur also with us, but all my red German specimens are, nevertheless, distinguishable at once from var. *grentzenbergi*; in particular, the central area always remains in them more or less grey (white grey) posteriorly, while in var. *grentzenbergi* it is red; the white lateral stripes on the prothorax and head also are often quite red in the Capri form; the light hairs at the end of the metathorax are always so. The white spots of the abdomen and the white margins of the segments become reddish in a few specimens only. On the other hand, the entire under surface, both of wings and body, is far redder than in even the reddest aberrations of *euphorbiae* from other localities. Whether the specimens from Capri are so red every year, or whether this is less the case in other years, still remains to be discovered (Staudinger). DISTRIBUTION: FRANCE: Haute-Garonne—Toulouse (Caradja). ITALY: Capri (Grentzenberg), Sicily—Taormino (Curò). PORTUGAL: Lisbon (*teste* Bartel).

In the Haute-Garonne, Caradja records having bred, from normal or dark larvæ, specimens as red as examples of var. *grentzenbergi* from Capri, whilst, from very bright yellow larvæ, he bred, in part, very large moths, which are almost normal in colour, but approach somewhat ab. *paralias*. One suspects the Haute-Garonne examples to belong rather to ab. *rubescens* than var. *grentzenbergi*. Staudinger notes the latter (*Cat.*, 3rd ed., p. 102) as "intensius rubescens."

ζ. var. (an ab.) *esulae*, Bdv., "Icones," ii., p. 26, pl. l., fig. 1 (1834); "Hist. Nat.," i., p. 163 (1875); Dup., "Hist. Nat.," supp. ii., p. 18, pl. ii., fig. 1 (1835); Frr., "Neu. Beit.," iv., p. 5, pl. 291, fig. 1 (1839); H.-Sch., "Sys. Bearb.," ii., p. 88 (1846), fig. 3 (1843); Staud., "Cat.," 2nd ed., p. 37 (1871); 3rd ed., p. 102 (1901); Rom., "Mém.," i., p. 70 (1884); Curò, "Bull. Soc. Ent. It.," xxi., p. 80 (1890); Kirby, "Cat.," p. 666 (1892); Bartel, "Pal. Gross-Schmett.," ii., p. 87 (1899).—Alis integris, anticis cinereo-ardusiaceis vitta pallida maculaque disci virescente; posticis nigris fascia media rubra margineque exteriori ardusiacea. Forewings whitish slaty-grey, with basal spot, discoidal spot, and a sinuous transverse band of obscure

olive-green; the ground-colour of that part bordering the transverse band internally more or less whitish; the discoidal spot preceded, as in *nicaea* and *euphorbiae*, between the summit and the costa, by a small olive spot. The hindwings black, with a transverse band approaching the red tint of *hippophaes*. This band shows, near the abdominal edge, a white rounded spot, &c. This insect has the shape of *euphorbiae*, but approaches *hippophaes* in tint; the markings are the same as in the former species, of which it is probably only a local variety; but as we have seen 8 exactly similar examples, it may be that the larva differs as much from that of *euphorbiae* as the latter differs from that of *nicaea*, although the imagines are only to be distinguished by size. We believe it to be a distinct species, but must await the discovery of the larva to confirm or refute this view. It is found in the south of Italy, the examples described came from M. Buquet. [OBS. I have a large number of *euphorbiae* reared in Sicily and Calabria that do not differ from those from the environs of Paris.] (Boisduval). GERMANY: Frankfort-on-Main (Herrich-Schäffer). ITALY: southern Italy (Boisduval), Sicily—Lampedusa (Failla-Tedaldi).

Erichson (*S.E.Z.*, ii., p. 5) and Keferstein (*ibid.*, p. 116) threw doubt on this aberration, believing the examples to which the name was applied to have been more or less artificially coloured. Staudinger notes it in his *Cat.*, 2nd ed., p. 37, as "an picta," but in the 3rd ed., p. 102, diagnoses it as: "A. ant. multo obscurioribus, al. post. limbo exteriore griseo," whilst Herrich-Schäffer describes and figures (*Sys. Bearb.*, ii., p. 88, figs. 7-8) "a ♀ example from Koch of Frankfort-on-Main. He says that it was bred amongst a large number of normal examples from larvæ found at Frankfort on *Euphorbia peplus;* Koch believed he had here a natural (not fraudulently darkened) example of *esulae*, but a comparison of my figure of *esulae*, which is quite true to nature, and of the examples I have for sale, will readily show the differences; *esulae* only differs from *euphorbiae* in its artificially blackened colour, while the present fine aberration has the same colour as an ordinary not very rose-red *euphorbiae*, but with the olive-green occupying the entire costa, and extending between the nervures in patches almost to the oblique hinder band; even more striking than the upperside is the strongly olive-green-mixed underside." Herrich-Schäffer then adds: "*Esulae*, Bdv., Frr., "n. Btr.," i., 291, H.-S., fig. 1, is, in the numerous examples which I have seen, a fraudulently dark coloured *euphorbiae*; and, according to Boisduval, who still holds it to be a local variety, it comes from the south of Italy; in Sicily and Calabria, however, the true *euphorbiae* also occurs." Boisduval, remarking on this, reiterates (*Hist. Nat.*, i., p. 163) that he saw 8 in M. Buquet's possession, that he gave 40 francs for a pair, and adds that Duponchel was inclined to consider it a hybrid between *euphorbiae* and *hippophaes*, an impossible hypothesis, as *hippophaes* is not found in Italy. Bartel, commenting on this evidence, says (*Pal. Gross-Schmett.*, ii., p. 87) that, although this aberration has been artificially imitated, yet there is no doubt of its being a natural aberration. Freyer (*S.E.Z.*, ii., pp. 125-126) conclusively satisfied himself that the original of his figure (from Herr Metzner, of Frankfort-on-Oder) was undoubtedly natural, and looked nearer *hippophaes* than *euphorbiae*. Lederer announced (*Verh. z.-b. Ver.*, ii., p. 91) that he had two aberrations of this form, without, however, indicating their locality, and later, Romanoff (*Mémoires*, i., p. 70) recorded a male example of ab. *esulae* from Tiflis, which was not, however, so dark as the examples figured by Freyer and Herrich-Schäffer. Wiskott ob-

serves that he has in his collection 3 ♂ s and 4 ♀ s of genuine natural *esulae* as well as two examples that have been artificially coloured. Wiskott's seven examples came from Frankfort-on-Oder, Breslau (1 ♀), Dresden (2 ♂ s, 1 ♀ from Kuhlmann), Leipzig (Müller), Austrian-Silesia (Troppau). According to Boisduval, it occurs in Tuscany, Calabria, Sicily, and, as just stated, Romanoff records it from Tiflis. Failla-Tedaldi records (*Nat. Sic.*, vi., pp. 103, 161), that he took two true ab. *esulae* on the Island of Lampedusa.

η. var. *peplidis*, Chris., "Ent. Nach.," xx., pp. 333-334 (1894); Bartel, "Pal. Gross-Schmett.," p. 88 (1899). *Robertsi*, Staud., "Cat.," 3rd ed., p. 102 (1901).—Caput et thorax olivaceo-fusci, scapulis albo-marginatis. Alæ anticæ albo-griseæ, costa, maculis, macula lata prope basin, macula costali pone medium sita vittaque postica olivaceo-fuscis. ♂, ♀. Near *D. tithymali*, Bdv. This interesting new species comes nearest to *D. tithymali*, and stands much further in all matters of superficial resemblance from all other species of the *euphorbiae*-group. . . . The larva is black and differs little from the dark form of the larva of *euphorbiae*. It has a red dorsal line which becomes yellowish on the segmental incisions. The yellow lateral line is broadened into a spot on the centre of each segment. The two yellow spots on each side of each segment are margined with deep black. On each side of the back are 4 rows of yellow dots. The caudal horn and the head are yellow-red in colour, the former posteriorly blackish. Venter black-grey. Legs exteriorly yellowish and black, interiorly red-brown (Christoph).

Two larvæ were found May 18th, 1873, on an unknown species of *Euphorbia*, on the chalk formation, near Schahrud in Persia, one of which produced a male, the pupal stage lasting about two weeks. In the summer of 1893, Herz captured some larvæ on the same plant, two of which produced a ♂ and ♀, the former agreeing with the one bred by Christoph. Bartel adds that it is only quite recently that *peplidis* has been determined as a local race of the highly variable *H. euphorbiae*. Staudinger refers it (*Cat.*, 3rd ed., p. 102) to *robertsi*, Butl.

θ. var. (an spec.) *lathyrus*, Walk., "Cat.," viii., p. 172 (1856); Butl., "Ill. Het.," v., pl. 80, fig. 1 (1876); Staud., "Cat.," 3rd ed., p. 103 (1901). *Paralias*, Staud., "Hor. Soc. Ent. Ross.," xiv., p. 297 (1879). *Euphorbiae*, Hamps., "Ind. Moths," i., p. 98 (1892).—*Deilephila lathyrus*. Viridi-fusca, subtus pallide, testacea; caput subtus, palpique apice alba; capitis thoracisque latera alba; abdominis dimidium basale lateribus albidis nigro quadrimaculatis, segmenta posteriora lineis transversis interruptis albidis; alæ anticæ testaceæ plaga basali, maculis duabus anticis lineaque obliqua postice dilatata viridi-fuscis; posticæ nigræ vitta subrosea, margine exteriore subtestaceo. *Deilephila lathyrus*, Boisd. MSS. North India. Coll. Stevens. (Walker).

Hampson writes (*Ind. Moths*, i., p. 98): "The Himalayan form *lathyrus* averages rather larger than the European *H. euphorbiae*, the latter averaging 60mm. — 80mm., the former 76mm. — 92mm." Staudinger notes it as: "Multo major, pallidior, imago nonnunquam a *nicaea* haud distinguenda." Kaye says that North Indian *lathyrus* is possibly distinct although very near *H. euphorbiae*. The head is larger, and the front portion of the thorax projects farther beyond the costa; the wings are slightly longer and narrower; the fascia of the forewings is much speckled, and there is very little pink in the hindwings; the black marginal band on the hindwings is much more extended, especially at the apex.

θ. var. (an spec.) *centralasiae*, Staud., "Stett. ent. Zeit.," xlviii., p. 64 (1887); "Cat.," 3rd ed., p. 103 (1901); Kirby, "Cat.," p. 666 (1892); Bart., "Pal. Gross-Schmett.," ii., p. 89 (1899).—Scapulis ubique albo-marginatis, al. ant. pallidioribus, unicoloribus (Staud., *Cat.*, 3rd ed., p. 103). Five examples of *D. euphorbiae* before me from Central Asia, 3 ♂ s and 1 ♀ from Samarkand and 1

♀ from Namangan, differ so strikingly from the European specimens of this species that they certainly deserve a name as a local form. They are, throughout, more blue in tint, and the black of the marginal band of the hindwings is not sharply, but indistinctly black, dull, and, in a measure, grey-black. The ground-colour of the forewings is a dirty (grey) sand-yellow, in the ♂ somewhat tinged with violet (not red); the olive-green basal and middle (costal) spots, as also the broad outer band, are also somewhat weakly tinted with yellow, the latter, indeed, only stands out little from the somewhat lighter violet-grey outer margin. The underside is dull grey-yellow, in the ♀, scarcely, but in the ♂ tolerably strongly, tinged with red, and one ♂ has an entirely red outer margin like so many European *euphorbiae*. The head, thorax, and abdomen also of a weaker olive-green than in our *euphorbiae*. The epaulettes are internally white-haired, though, in two examples, only very slightly, and not nearly so strongly as in *D. mauretanica*. Probably this pale unicolorous var. *centralasiae* occurs only in the low-lying sand-steppes, whilst the Central Asian *euphorbiae* from higher ground may come nearer the European form. The colour of var. *centralasiae* stands in a similar relation to *euphorbiae* as does *D. bienerti*, Staud., to *D. hippophaes*, Esp., and I now hold the former to be a local (steppe) form of *hippophaes*, for, although the Central Asian *bienerti* never shows the small black dot at the end of the forewings which *hippophaes* always has, yet it shows transitions in colour from one into the other, and, particularly, the larvæ of *bienerti*, are almost entirely like those of *hippophaes*. DISTRIBUTION.—ASIA: Samarkand, Namangan (Staudinger), Pamir—Oche (Grum-Grshmailo).

Bartel notes (*Pal. Gross-Schmett.*, ii., p. 89) that this striking local form is much paler than the type, and is recorded from Turkestan: Samarkand, Namangan, Osch, and Fergana. It appears in May, and is said in its limited steppe localities to be somewhat common. Kaye observes that the only example in the British Museum collection, is smaller, and with the fore- and hindwings much more rounded than in typical *H. euphorbiae*. Both fore- and hindwings, too, are much greener. The discoidal blotch is much more rounded and distinct, and there is no mark beyond the blotch near the costa. The black marginal band of hindwings is quite even on the outer edge and well-curved, following the shape of wing, although this is, in all the forms of *H. euphorbiae*, a much more variable character. It is difficult on a single example to enter into the question of the specific value of this insect. Püngeler (*Berl. Ent. Zeits.*, xlvii., p. 237), on account of the great difference in the preserved larvæ which he possesses (from Askabad), is decidedly of opinion that it is a good species, especially as *H. euphorbiae* also occurs in the same neighbourhood.

Staudinger treats the following as a local race of *H. euphorbiae*. It appears to us to be, however, a distinct species, and we give the diagnosis simply for reference—

HYLES ROBERTSI, Butl., "Proc. Zool. Soc. Lond.," 1880, p. 412, pl. xxxix., figs. 9-10 (1880); Staud., "Cat.," 3rd ed., p. 102 (1901). *Dahlii*, Hamps., "Ind. Moths," i., p. 99 (1892).—*Deilephila robertsi*. ♀. Primaries above much elongated (more than in *D. tithymali*); chalky-white, with a snow-white basal spot, the markings consisting of a large oblong subbasal patch, the costal border, a very large subcostal patch beyond the cell (with a rectangular excision out of the infero-exterior portion), and a broad discal belt, tapering towards the apex, bright olive; the second and third median veins white externally; external border very slightly tinted with lilacine, but scarcely perceptibly; a black spot close to base of internal border. Secondaries black, with brown costal border, a dull rose-red discal belt commencing on the abdominal border in a large snow-white patch, as in *D. hippophaes*; external border pale flesh-tint, fringe white. Body olive, sides of head and thorax, margins and fringe of tegulæ, antennæ, and anterior margins of abdominal segments snow-white; the three basal segments snow-white at the sides, the two basal ones with the white area interrupted by large velvety-black spots. Under surface pale sandy-greyish, with a paler discal belt on the wings; primaries

with a few blackish scales towards the anal angle. Expanse of wings 3ins. 1 line. On the upper surface of the primaries this species most nearly resembles *D. dahlii*, of the secondaries *D. hippophaes*, of the body *D. esulae*, and on the undersurface *D. lathyrus*. The olive tint of the thorax and the markings on the primaries are greener than in any species with which I am acquainted. FOODPLANT: The larva of this was found on almost every plant of a species of *Euphorbia*, which is very common on the rocky hills here. The larvæ are very beautiful and conspicuous, and are very different in colouring according to their different stages of growth. It is quite distinct from a common one obtained in Kashmir, which was found on a different species of *Euphorbia*, and was abundant at Goolmurg. LENGTH OF PUPAL STAGE: About half the cocoons produced moths in about three weeks after changing; the remainder are still (December 31st, 1879) alive in the pupal state; curiously enough the first larva that changed is among the latter. LARVA: About 3″ long when at rest. Anterior segments attenuated, not retractile; skin smooth and soft. General colour black, with white dots and spots; a subdorsal row of large white roundish spots, one on each segment, either yellow, orange or red; a dorsal stripe varying in colour, but generally the same as the spiracular blotches; it is, however, sometimes only partially represented, and sometimes absent; when present, it is broadest at the interstices, where it sometimes differs in colour from the portions between; feet, head, back of head, and base of horn either yellow, orange or red, generally the same as the spiracular blotches and dorsal stripe; horn slightly rough, curved, rather longer than the segments, black, with the rear-base either orange, red or yellow (being the continuation of the dorsal stripe, broken by the horn, and is consequently absent in those which have no dorsal stripe); spiracles white and rather narrow ovals; head globular; belly pale yellowish-green, extending up the interstices to above the spiracles. Kandahar, beginning of May, abundant, all sizes. VARIATION OF LARVA: At the end of May most of the larvæ found presented a different appearance; the black disappears more or less, and with it many of the small white spots. In some cases the black only remains as a ring round the larger white spots; the ground-colour, therefore, becomes yellowish-green or yellow, varying very considerably; the horn becomes black at the apical half, with the basal half the same colour as the dorsal stripe. The larvæ are, therefore, exceedingly variable in colouring (the large white spots always remaining the same, however); some specimens are, consequently, so unlike one another as, at first, to appear different species; every intermediate form, however, being found does away with the idea. HABITAT: The foodplant grows in the nullahs and on the slopes of the rocky hills, and is very common, but scattered; and almost every plant that now (end of May) has any leaves left on it, has several larvæ feeding on it. HABIT OF LARVA: This larva, like others of the same genus, emits a large amount of a green fluid from its mouth on being irritated in the least for the first time, not often doing it a second time. PUPATION: This species does not change colour when seeking for a suitable place for its cocoon, which is at or near the surface of the ground, amongst rubbish (Butler *quoting* Roberts *in litt.)*.

Staudinger makes (*Cat.*, 3rd ed., p. 102) *peplidis*, Chr., a synonym of *robertsi*, Butl., and diagnoses the latter as: "Scapulis ubique albo-marginatis, al. ant. grisescentibus." Hampson writes (*Ind. Moths*, i., p. 99) that *robertsi* "differs from *gallii* in the thorax, having two white stripes, the tegulæ being fringed with white on the inner side also; the abdomen as in *euphorbiae*, forewings as in *gallii*, the hindwings with the band pinker. Some specimens have the segments of the abdomen fringed with blue scales, and the veins on the outer area of the forewings streaked with white. Kandahar, Simla. Exp. 82mm."

EGGLAYING.—The eggs may be laid singly or in small batches on the tops of the young shoots of the *Euphorbia*, one batch found consisted of about a dozen eggs (Harrison). The parents do not seem to exercise much judgment in depositing their ova; sometimes three or four young larvæ are to be seen upon a small plant not more than 3ins. high, and no other plant within 100yds. of them; in many instances again, several small larvæ were noticed upon

a diminutive plant, while large robust plants close at hand had none on them (Mathew). The eggs are laid at the top of the plants among the soft budding leaves (Melhuish), light green in colour and usually eight or nine near together (Johnson). The eggs when laid, are covered with an adhesive gummy substance, by means of which the ♀ fastens them to the small leaves of the spurge (Raddon). In confinement the eggs are laid at the base of the leaves of *Euphorbia cyparissias*, in small clusters, composed sometimes of as many as seven, the single eggs being placed near together, but never touching, and seldom at the point, of the leaf, but generally near the end of a twig, where young shoots are in close proximity (Weismann).

Ovum.—Bright pea-green in colour, semi-transparent in appearance; nearly spherical in outline; length 1·1mm., width 1mm.; one end very slightly broader than the opposite; surface smooth, covered, however, by a small and faintly marked cellular pitting or faceting. [Eggs received from Dr. Chapman.] (Bacot). Green, very small in proportion to the size of the moth, smaller than those of *Mimas tiliae* (Bartel). The eggs much resemble those of *Eumorpha elpenor*, being spheroidal in form, but rather smaller, and of a somewhat darker green. During the embryonic development the eggs become coloured, first yellow, then partly blackish, and, finally, completely black (Weismann).

Habits of larva.—The newly-hatched larva does not eat the eggshell (Sich). When quite young, the larvæ are always found among the soft budding leaves at the top of the plant, working their way down, eating leaves, stalk, flowers, and seeds, all except the central stem, till they reach the ground when they run off in search of fresh food, leaving behind them a broad trail in the sand in which each foot's tread may be distinctly traced. Stripped plants are a sign that the larvæ are gone but they will be found not far off; if leaves be withered they will be underground, but, wherever there is a green-looking bed of *Euphorbia*, you are sure of a score or two. They prefer the seedvessels and young stalks as these contain most of that milky juice which is their great delight, and, if a twig be broken, they will fasten on the broken end and lick up the milk as it oozes out. The seedvessels they take between their front legs, and, raising themselves into the *Sphinx* posture, gnaw away at one till it is demolished, just like a monkey with an apple, their feet close before their mouths; if interrupted when feeding they turn round with the greatest fury and spit out a quantity of green liquid of an acid and disagreeable smell, similar to that of the spurge-milk only worse. When a larva after rambling about finds a fresh plant to its taste it sets to work at once upon the bottom leaves, merely raising up its head from the ground, and devours all within its reach, before proceeding to climb the stem; these bottom leaves are, of course, very inferior, but were the large larvæ, who are old enough to travel, to mount up to the top at once and eat all the tender shoots, all the little larvæ just out of their eggs would be starved. A larva never turns—it goes up or down according to circumstances, but only one way; they must swallow large quantities of sand, for, however sandy a leaf may be, if it be fresh they never reject it on that account. Trails and frass are proof positive of the

recent visit of larvæ even when the latter are not visible as they are soon covered with sand. They run over the sand with great ease in search of a fresh plant and are very active between 3 p.m. and 6 p.m. They are most abundant at St. Pol de Léon during the first week of September 400 being collected in three days. Curtis states (on the authority of Raddon) that the young larvæ are not easily discoverable, but that, when large, they are so conspicuous that their numbers are reduced by marine birds which feed upon them; they can also, at this stage, be traced by their frass and are sometimes to be seen resting at the extremity of a culm of a small rush, and, at Braunton Burrows, used to be fullgrown about the middle of September. In the Channel Isles near St. Helier, the larvæ were formerly collected in August (Batho), whilst at St. Poldu, Harrison reports that larvæ were abundant at end of July (28th-29th), 1897, and that pupation commenced by August 4th, whilst John found larvæ in the Forest of Fontainebleau, August 1st-4th, 1872, which, being sent to Buckler, pupated between August 9th-18th. Chaumette observes (*Zool.*, ix., p. 3158) that the larvæ, known to Swiss children as "Chenilles de Tithymali," are usually more or less gregarious, that as many as 150-200 may be found in one spot, often fewer, but rarely solitary; he further notes that, in feeding, they gnaw the lower leaves of the spurge from apex to base, and eat very rapidly. We have repeatedly found the larvæ in Switzerland, Dauphiny and Piedmont, and have also noticed this gregarious tendency, and, large and conspicuous as these larvæ are when looked for, it is easier to walk over them than see them at a casual glance. Their lazy habits are beyond belief, and their powers of eating extraordinary. The larva will stand on a stem of the foodplant, eat the leaves one by one, commencing at the top, as well as the stem itself, only stepping backward as the stem becomes shorter, and at once reach forward to the nearest leaf. Some in confinement did not move during the night, but were found in the same position as they had taken up the previous night. Between Evolena and Villar they were exceedingly abundant in early August, 1899, the smaller ones clinging to, the larger stretched across, the foodplant in the morning sun, and again their general similarity to their surroundings was noticeable, due, it would appear, entirely to the effect of light and shade on the hues of the larva, producing a general resemblance to the colour of the leaves and blossoms of the spurge on which they rested; there was no special part of the plant to which the larvæ bore a special resemblance, and a larva, practically invisible in one position, often became quite conspicuous from another standpoint. Merrifield observes that, in the Vals-Platz, they are conspicuous enough, lying across their foodplant or sometimes on a grass bent arising out of it, and are very sluggish, except, occasionally, when crawling from one patch of their foodplant, nearly eaten down, to another. After commenting on the conspicuous spots of these larvæ, the same observer details (*Ent. Rec.*, xii., p. 320) an experiment tending to prove their inedibility as far, at least, as fowls are concerned. Weismann, on the other hand (*Studies in the Theory of Descent*), states that a lizard that would not eat a larva of *Celerio gallii*, at once attacked and swallowed a large larva of *Hyles euphorbiae*. Mathew states that, in Malta, the larvæ are much attacked by cen-

tipedes and that carnivorous beetles prey on them at night. Buckler observes (*Larvae*, &c., ii., p. 31) how the appetites of some larvæ that he had from Fontainebleau seemed insatiable, each larva embraced the seaspurge with all its legs, ate voraciously, and, at length, when compelled to stop, it would go to sleep without change of position and with a partly-devoured leaf in its jaws, and then, after a few minutes' repose, it would wake up, finish the leaf, and attack whatever came next—leaves or seedvessels—most vigorously, there was no walking about, the only movement was a step or two backward as the stem shortened beneath its jaws; during eight days he was busy picturing them, and none sulked or shrank when the sun shone on them, or when, for closer inspection, they were taken in the hand, only, as each matured and ceased feeding, it grew active and lively, exhibiting its capacity of walking at a great pace for a day or two before settling down to its change. When handled, or irritated, the larvæ exude from the mouth a large quantity of dark green fluid that smells strongly of its food-plant, and often throw it for some distance by means of a sudden jerk of the thoracic segments. Harrison observes (*Ent. Rec.*, ix., p. 293) that, on July 28th-29th, 1897, he took some 120 larvæ feeding on *Euphorbia paralias* on the coast of Brittany at Le Poldu; the larvæ were in all the various stadia and very abundant. The young larvæ, until in the 3rd instar, rested on and ate the tops of the young shoots, eating through the stalks below the seeds, so that the sand all round the eaten plants was covered with the seed-heads, but, at the 3rd or 4th moult, the larvæ feed on the leaves at the base of the red stalks. The larvæ seemed always to occur in pairs, although the only batch of eggs found consisted of about a dozen. He further observes that the fluid exuded by the larva causes a very violent irritation if it gets into scratches or into the eyes. The larvæ are sometimes found in great abundance and vary exceedingly in size at the same time in the same locality. Eaton observes that between April 27th and May 4th, 1894, near Biskra, he saw what he estimated to be between 1000 and 2000 larvæ of different ages, some in the blackish juvenile stage, others 3ins. long, and states that, standing still anywhere, where the foodplant grew, he could see 4—6 larvæ without stirring, but, in exceptionally favourable places, they were much more numerous, and, within the space of a quarter of an acre, some 500 were actually counted; a few bushes of *Euphorbia guyoniana*, occupying each about a square yard of ground, had on them over 20 or 30 larvæ apiece. White observed them of all sizes and in great numbers at Capri in May, 1866. In Transcaucasia, according to Romanoff (*Mém.*, i., p. 70), the larvæ of *H. euphorbiae* appear in certain years in such great numbers that they cannot find enough food, and must perish through hunger. Thus, in 1879, on the railway from Tiflis to Kodigori they appeared in such abundance as to astonish travellers in the district. Chapman notes (*Ent. Rec.*, ii., p. 201) that, on the "Landes," he observed the stems of *Euphorbia* eaten in such a manner that he thought he had found a larva of *H. euphorbiae* where there was none, the bases of the leaves appearing as round coloured spots, an appearance that he considers the larvæ obviously mimic. He adds that, in Capri, the larvæ feed openly and abundantly on a shrubby *Euphorbia*, where its aspect

seems to make it intentionally conspicuous as a warning to enemies. Mathew writes *(in litt.)* that the abundance of the larvæ from April to December, at Malta, suggests continuous-broodedness in that locality, imagines as early as April 14th, larvæ about a quarter grown on April 27th, and larvæ continuously on until December 4th, when some were quite small (possibly the larvæ of the April imagines), helps to bear out this view, but they are most abundant from July to October, and are sometimes so numerous that they devour nearly all their foodplant, and may be observed wandering about looking for more; many of these, he thinks, must die of starvation. The larvæ collected produced imagines very quickly as a rule, but some examples of one lot, taken in the autumn of 1897, remained in the pupal state for more than 12 months. They began to emerge in June, 1898, two appearing on the 17th, and others during July, August, and September, whilst the ship was in various parts of the Mediterranean; the last, however, did not come out until after his return home, and emerged at Dovercourt on November 12th. The following table gives some interesting details:

DATE.	LOCALITY.	REMARKS.
Nov. 2, '62	Gibraltar	Took 7 fullgrown larvæ on *E. paralias* on sandhills on the "neutral" ground. There had evidently been a large number, but the others had spun up.
Nov. 11, '62	,,	Took 9 more larvæ. Dug in the sand at the roots of the spurge, but could not find any pupæ.
Sep. 7, '64	,,	Larvæ same locality, common.
July 6, '78	Bulair Lines, Sea of Marmora	Found 6 fullgrown larvæ.
July 26, '78	Gallipoli	Bred one of above.
June 7, '97	Crete	Frequently attracted by our electric lights.
July 10, '97	Malta	Larvæ of all sizes abundant.
Sep. 30, '97	,,	Small larvæ still about.
Oct. 14, '97	,,	Larvæ of all sizes still to be seen—many of the small larvæ are destroyed by large spiders and centipedes.
Oct. 18, '97	,,	
Oct. 25, '97	,,	Larvæ abundant.
Nov. 4, '97	,,	Small larvæ still plentiful.
Dec. 4, '97	,,	Saw several small larvæ, but they did not look very lively—weather has been cold lately.
April 14, '98	,,	One caught ou board.
April 27, '98	,,	Saw and took several larvæ about quarter grown.
May 11, '98	,,	Larvæ taken on April 27th spinning up.
May 19, '98	,,	Bred one of above.
June 17, '98	At sea	Bred 2 from larvæ taken at Malta last autumn.
June 28, '98	,,	,, ,, ,,
July 1, '98	,,	,, ,, ,,
July 29, '98	Alghero, Sardinia	One bred from larvæ taken at Malta last autumn.
Aug. 19, '98	Leghorn	One ,, ,, ,,
Aug. 30, '98	Naples	Two ,, ,, ,,
Sep. 4, '98	Palermo	One ,, ,, ,,
Sep. 5, '98	,,	One ,, ,, ,,
Sep. 7, '98	At sea	One ,, ,, ,,
Sep. 9, '98	Malta	Two ,, ,, ,,
Sep. 10, '98	,,	One ,, ,, ,,
Sep. 16, '98	,,	One ,, ,, ,,
Nov. 12, '98	Dovercourt	One ,, ,, ,,

As showing the long period over which larvæ are to be found in France, we may note that Réaumur obtained fullgrown larvæ near Paris on July 15th, which pupated directly afterwards; he further observes that larvæ also were extremely common between Bevis and Langés on the banks of the Loire in early September, very few pupated before September 20th, and imagines did not emerge until the commencement of the following July. The larvæ are usually found in July and August on the west coast of France, and they used to be most abundant in July and August in Jersey before they were exterminated there. Chaumette, too, observes that, at Lausanne, larvæ occur from the middle of June to the end of October, whilst Bell reports that, in the neighbourhood of the Bilbao river, larvæ are very abundant in June and again in September. Jones observed larvæ from July 24th-27th, 1894, at Gerolstein in Rhenish Prussia, and Walker in June and October in the cork woods of the Gibraltar district, whilst Bachmetjew notes that they are common everywhere in the Sofia district in August and September. Eaton says that larvæ were exceedingly abundant from April 27th-May 4th, 1894, near Biskra, but from here no summer or autumnal records are available. We may add, as bearing on the continuous-broodedness of the species in the Mediterranean, that Fletcher found the larvæ common on October 5th, 1901, at Lemnos, and a few fullfed ones at Volo as late as November 3rd, and that Mathew has found them commonly on both sides of the Sea of Marmora in October and November.

Larva.—*First instar* *: Largest 8·75mm. Head, legs, scutellum, anal plates, tubercles and hairs black; the skin-surface dusky green. The larva tapers slightly from the 7th and 8th abdominal segments towards the head; the subsegments appear to be 6 on the meso- and metathorax, and 8 on the abdominal segments, but the first three subsegments are obscure and appear as a large 1st subsegment, followed by 5 smaller ones. The skin-surface granular, with no trace of spicules to be seen. Head dull black, the surface finely granulated with usual hairs. Scutellum and anal plates black and chitinous. True legs shiny black; small black chitinous plates at base of prolegs; caudal horn short, blunt, only tapering slightly, black, chitinous, thickly covered with small, rather broad-based thorns that are apparently analogous with the prickly-looking hairs that usually cover the horn in other species, the hairs at summit (i of 8th abdominal) black, and short in comparison with those of such species as *Sphinx ligustri* and *Amorpha populi*, but much longer than the other body-hairs, blunt-ended, but not enlarged nor notched at tip, their bases quite a considerable distance apart owing to the blunt character of the horn. The tubercles are arranged as follows: i and ii are arranged trapezoidally on separate subsegments on the meso- and metathorax, and only a little more than half the distance apart of i and ii on the abdominal segments, where they are set at corners of an oblong rather than

* As to the number of moults, Sich notes (*Ent. Rec.*, xv., p. 68) of the dates of the moults of a larva he reared, and that hatched August 10th, 1901, as follows: First moult, August 17th; second moult, August 26th (when it appeared to miss the third and reach the fourth phyletic stage); third (and last) moult, September 2nd. It ceased feeding on September 14th.

a trapezoid, and separated from one another by two subsegments (being placed on subsegments 2 and 5); on the meso- and metathorax iii is a twin-haired oval tubercle, and there is a single-haired subspiracular (? v) on the anterior margin of segment. The 1st abdominal differs from all other segments in that iv and v sometimes form a twin-haired, oval tubercle *, directly beneath the spiracle, whilst the spiracle and iii (directly above spiracle) appear to be further forward than on the other segments, and are apparently situated on the 3rd subsegment. On the other abdominals iii is directly above the spiracle apparently on subsegment 4; iv is directly beneath the spiracle, and larger than v which is quite close to the anterior margin, apparently on the 1st subsegment, and slightly above the level of iv, but they are both clearly situated on the lateral flange which is, however, only slightly marked. Hairs very short and stumpy, but apparently blunt-ended and neither knobbed nor forked. The 8th abdominal spiracle is much the largest, the 7th abdominal comes next and that on the prothorax next, whilst those on abdominal segments 1—6 are not more than half the size of that on prothorax so that the disparity in size between those on the 7th and 8th and the other abdominal segments is very great. There is a pale narrow mediodorsal line. [Bacot. Described from larva received from Chapman, preserved in formalin.] *Second instar* (still wanted). *Third instar:* Plump, full-bodied, but not squat; tapering gradually from 3rd abdominal segment to last thoracic, and thence more rapidly to head. The head is small for a well-grown larva of this size, rounded and but slightly taller than wide. The horn is short, upright and pointed, carries two bristles at summit, and has a thorny appearance, due to numerous smaller bristles, and their conical bases scattered upon it, the skin of horn is shiny and chitinous-looking, black for upper two-thirds, yellow or orange at base. The true legs are black. There are 8 subsegments to each segment, the first three of which form one large division which appears to present both a structural and a colour character. The larval colours are very brilliant and sharply contrasted, consisting of vivid green-yellow with intense velvety black and white spots. The head is black and orange, the crown and face black, with a varying area of orange, which may be only a narrow streak or a broad band or belt, running horizontally round the sides of the head and across the face, just above the mouth. The body colours also vary in the proportion of green-yellow and black, in some larvæ the black area being much increased. There is a broad bright yellow mediodorsal band from head to base of horn, it commences again behind the horn and is continued to the anus; the ground-colour of the

* Reference to larvæ of *Theretra porcellus* and *Sphinx ligustri* in 1st stadium shows that in these iv and v are well separated on the 1st abdominal, both are on the lateral flange at or near the same level. Larvæ of *Celerio gallii* and its allies in this stadium are unfortunately not at hand for reference so that I cannot say whether this marked aberrational character of united iv and v in *Hyles euphorbiae* is ever found in them (Bacot). Chapman notes that the larva of *H. euphorbiae* examiued by Bacot must have beeu aberrant, that he has examined two larvæ, in both of which the arrangement of iv and v on the 1st abdominal is such that, although brought nearer together, iv and v still remain quite distinct and at some distance from each other. A subsequent examiuation of 8 examples in Bacot and Chapman's possession results in showing that tubercles iv and v on 1st abdominal are: (1) Left conjoined, right normal. (2) Left conjoined, right approximated. (3) Left uormal, right conjoined. (4) Left conjoined, right coujoined. (5-8) Normal on both sides (*vide, Ent. Rec.*, xv., April no.).

larva is then black to the lateral line, broken, however, by a series of yellow or green triangles of smaller or larger size, with one side vertical against the base of the segment, another side at right angles, running horizontally to the forward apex, which is just behind the enlarged subdivision consisting of the first 3 subsegments, the third side slopes obliquely backwards at an angle of about 45°. On the thoracic and on the 1st and 2nd abdominal segments the front apex is cut off, giving this yellow or green area an irregular shape. Situated on the enlarged 1st subdivision of the segments is a subdorsal series of brilliantly white rounded or oval spots; in some larvæ there is a second row of much smaller spots beneath and rather anterior to the spiracles, in other larvæ this is quite absent. The secondary body-hairs (analogous to the shagreen-hairs of other species) are minute, very short, black bristles with their bases not raised as mammillæ, but, where they occur on a black skin area, other than on the 1st enlarged subsegment or in near proximity to the subdorsal white spots, they are surrounded by larger or smaller white specks. It is also curious to observe that, where the black encroaches on the yellow or green (paler) areas, it always does so at first as streaks and dots, at mid-distance between the hair-bases, as though there was some antagonism between the black pigment and the hair-base; it is this feature that produces the tessellated appearance so characteristic of the Eumorphid (*Theretra porcellus* and *Eumorpha elpenor*) larvæ, and no doubt it is an analogous trend that, in *Smerinthus* and *Sphinx*, has produced mammillæ and pale or brighter coloured areas at the base of the secondary hairs. Whether the primitive Sphingid larva had tessellations or pigmented mammillæ is doubtful, more probably the pigmented specks of the Phryxid and Sesiid larvæ represent the primary form. In any case, we may consider that the secondary (shagreen, mammillary or pigmented) hairs are a phylogenetically old and important character of the Sphingid larva. The spiracles are white, and beneath them is a broad subspiracular stripe, yellow where it is raised and flange-like near the spiracle, but green at the anterior and posterior portions of the segments, whilst beneath is a band of black, speckled with white. The venter and prolegs are green, but the side plates of the prolegs are black. In some larvæ, and in the 4th skin of most, the black area is much increased, the black encroaching up the segmental incisions, cutting up the ventral area into yellowish or greenish spots surrounded with black, thus giving the pattern so often found in twig-resting larvæ of various families or superfamilies. *Fourth instar:* The only change in larvæ that have assumed the 4th skin, is for the black and white to be increased at the expense of the yellow, the green having merged into yellow. The horn is thicker and rougher. The yellow on the head has deepened into vivid orange, and the mediodorsal stripe is also orange where it crosses the scutellum. [Bacot. Larvæ received from Dr. Chapman, early July, 1902.] *Fifth (Adult) instar:* Very brilliantly and crudely coloured (strongly suggesting warning coloration). In the black ground-colour, and the large yellow shagreen-spots (and the more or less absence of these on the enlarged 1st subsegment), the larva bears a marked resemblance to that of *Celerio gallii*. Head, anal plates and prolegs red; a subdorsal series of large pale yellow spots from prothorax to the 8th abdominal, situated

on each of the enlarged subsegments; the series duplicated by a row of rather smaller spots immediately beneath it, and above the spiracles. The head rounded, inclining to be tall and with a slight suggestion of being trapezoidal, brilliantly red, with a smooth but not highly polished surface; a band of black just above the mouth, the upper portion of labrum and bases of antennæ pale yellow, the tips of antennæ, lower edge of labrum, and other mouth-parts black; the true legs also black. The body black (duller and less satiny than in *C. gallii*); scutellum black; anal plates bright red; caudal horn red, looking like a piece of red coral, rather upright and blunt tipped (? nibbled by other larvæ); a dark red mediodorsal band, rather broader where it crosses the scutellum than elsewhere; a broad, bright, rather deep yellow, lateral band, with a series of bright red spots on it just beneath the spiracles, these spots very faintly marked on meso- and metathorax, but quite absent on prothorax. The ventral area with a broad mediodorsal band of pale dirty-looking yellow, broadening on the abdominal segments and including the bases of the prolegs within its area, and ending at the anal claspers. The spiracles white with a black chitinous rim; the prothoracic and 7th and 8th abdominals slightly larger than the others. Scutellum bordered subdorsally by a short stripe of cream colour, a modification of the subdorsal spots present on the anterior subsegment of other segments from mesothorax to the 8th abdominal; the upper spot on the 8th abdominal elongated upwards towards base of caudal horn. The pigment-spots surrounding bases of shagreen-hairs are largely absent from the middle area of the enlarged subsegment that bears the subdorsal series of spots, being almost entirely restricted to a band on the anterior and posterior portions of the segment save for a few on the centre of the dorsum. The mediodorsal band is bordered with pale yellow behind the caudal horn. Hairs black and very small (Bacot. October 30th, 1901. Larvæ sent by Fletcher from Malta). ? *Third instar*:* About ·75in. in length; body yellow or yellowish-green in colour; the head small, almost of the same tint as body, with two dark spots on crown, analogous with the dark markings on either side of each body segment, and in which are the white spots that characterise this larva; a yellow-green mediodorsal line, bordered on either side with a fine black and white latticed reticulation, which forms, as it were, two lines edging the mediodorsal, and uniting the tops of the black marks in which the white spots are placed; the spiracular line has more of this reticulation, whilst directly below is a marked yellow subspiracular flange, broken by the segmental incisions; below this again the black and white reticulation takes the form of two or three white spots, ringed with black at the base of each proleg; the prolegs themselves are green with a dark spot on the outside of each, whilst between each pair is a smoky quadrangular ventral spot, the spots being less distinct, though present, on those abdominal segments without prolegs; the true legs are black. The 8th abdominal segment, bearing the black caudal horn, is the darkest segment, but, whilst the 9th abdominal

* These are more or less duplications for comparison with Bacot's much more complete descriptions immediately preceding.

segment carries a white spot on either side, the 10th consists merely of the anal flap and prolegs. ? *Fourth instar:* [Larva moulted between 5 a.m. and 6 a.m. on August 12th, 1899.] The head, thorax, anal plate, prolegs and caudal horn were entirely yellow directly after the moult. By 11 a.m., the tip of the caudal horn, the head, and the thoracic segments were considerably darkened, but the fuller dark colour was not obtained till about 6 p.m., *i.e.*, until some 12 hours had elapsed. The larva exactly ·75in. long in its old skin, was ·9in. directly after moulting, the head and caudal horn comparatively large; the skin wrinkled. Head bright yellow, with a black spot on either side of crown; the front edge of prothorax folded so that the white skin, laterally, is homologous with the white pair of spots on the succeeding segments (these two spots united on mesothorax), the prothorax otherwise entirely black; there is a bright yellow mediodorsal line including the base of the caudal horn; the first subsegment of each segment is black and contains the two characteristic white spots; the remainder of the body-surface now covered with pale yellow and black reticulations (in the form of black rings that include the pale ground-colour), whilst the lateral area is yellower than the dorsal and subspiracular areas; the subspiracular flange (still broken) is bright yellow, the reticulated area continued below the flange ventrally to the line of the prolegs, which are still yellow, and bear a dark plate externally; the 9th and 10th abdominal segments appear to have separate spots, whilst the strong anal prolegs are yellow with external black plates; ventrally, the larva is greenish, with black spots between prolegs (also present on abdominal segments 7 and 8) very marked, whilst the characteristic reticulation of dorsum and sides is continued on the venter of the 1st and 2nd abdominals; the white spots of the reticulation, directly below the flange on the thoracic segments, form a sort of secondary inferior flange above the black legs; the caudal horn still black, the tip blunter. The larva grows to 1·5ins. or 1·75ins. in this stadium. ? *Fifth instar* (newly-moulted): [When the larvæ first enter this instar some three forms are observable; as they become fullfed, the proportion of the various colours changes and there are finally scarcely two specimens alike. At the commencement of this instar they are about 1½ins. long but they feed up rapidly and quickly, and reach a length of from 3ins. to 4ins.] (1) Ground-colour green, the spots on the crown of the head reduced; the prothorax green, large in proportion to size of head, the black reduced to a lateral mark containing the white spots (united), as on the succeeding segments; the true legs yellow with black hooks; the segmental incisions green; the reticulation fails in part, so that, laterally, a square spot of the ground-colour is left on each segment between the white spots and incision behind; the dark colouring of the plates on the outside of the prolegs (anal included) is wanting; the caudal horn with a blunt tip. (2) Much more intensely coloured; the head orange-yellow with a black edge separating it from the mouth; the black much increased on the front of each segment; the mediodorsal line deep orange-yellow as also is the caudal horn, except the tip; the whole of the segments closely reticulated; the yellow lateral spots (described in the preceding larva) deep orange, but more or less included in the ground-colour; the lateral flange is deep yellow, but the true legs, prolegs,

anus and anal prolegs are orange-yellow; the plates on the outside of prolegs colourless; the reticulation continued ventrally on the 1st abdominal segment. (3) Head red; the skin of the prothorax, mediodorsal line, caudal horn, lateral flange, true legs, prolegs, anus, and anal prolegs deep red in colour; the lateral spots on either side of each segment (instead of being white or yellowish-white) deep yellow; ground colour of dorsal area very yellow; the black reticulation and black anterior subsegments strongly developed; the ground-colour of spiracular and subspiracular areas white; the ventral surface red, with a yellow spot in front of each of the dark ventral abdominal spots. *Fifth instar* (full-grown): 3ins.-4ins. in length. Much variation exists. The wrinkles in the skin (noticeable in newly-moulted larva in this instar) have disappeared, the larva is sleek, smooth, and shiny; the head (which is large in proportion to size of body directly after moult) comparatively small, and there is a distinct snout-like appearance about the head and thorax as in the so-called Chœrocampid Eumorphids. Under a lens the whole of the pale (white, yellow, or orange) spots appear to be set in the black ground-colour. The head and segments are covered with very fine dark hairs (shagreen-hairs), the bases of which are very conspicuous in the pale spots just alluded to. The ocelli are placed very low down on the cheeks on the dark area that forms the upper boundary of the labrum. The spiracles make a very fine wide double lip, have a very conspicuous lumen, and are placed transversely on the 1st subsegment of the abdominals, above the lateral flange, at the posterior and inferior border of the lower (paler) of the two lateral spots on this subsegment. The anal segment, anal prolegs, and ventral prolegs are covered with short bristly hairs, and there are some short hairs of the same colour as the skin on the true legs. The black hooks of the legs and prolegs are sufficiently strong to tear the epidermis from one's fingers (Tutt. Described from Evolena larvæ August 10th, 1899). *Another larva quite fullfed in fifth instar*:* The head red rather than red-brown, shining, almost smooth, although sparingly sprinkled with minute pale yellowish hairs; mouthparts black, edged above the labrum with yellow, and fringed with longer pale hairs; two small black patches at bottom of cheeks look as if part of mouth; on edge of each patch are 5 red-brown ocelli in form of a concave curve (the 5th very low down at base of antenna), a 6th ocellus in normal central position; the antennæ short, 2-jointed, pale, on a pale conical base, the upper part of which is movable with the antenna, the terminal hair probably homologous with another joint. The prothorax small, but forming a hood over head, broadly red centrally (commencement of the mediodorsal line), but with the ground-colour black, shiny, and having a yellow transverse patch at the front, on each side of the mediodorsal line; prothoracic spiracle formed of two closed creamy-white, closely appressed, lunular halves, with fine, slightly raised, black external rim; an oblique, red, tumid, muscular flange on each of the thoracic segments, each connected with that on the succeeding segment; ventrally, the thorax is pale reddish,

* This description was made quite independently of, and earlier than, the preceding. In such an interesting and variable species we have no hesitation in giving our readers as much material for comparison as is available.

the true legs red, with a single strong black claw, a ring of black hairs at joints. The thoracic segments gradually increase in size, and this enlargement continues to the 3rd abdominal segment; then the segments are pretty uniform to the 8th abdominal, which carries the caudal horn, the 9th is contracted, the anal flap reddish, the anal prolegs arising from the central portion. A red mediodorsal line extends from head to anal flap, the caudal horn red with black tip, and moderately large in proportion to the size of the larva. The ground colour of the body is black, thickly covered with yellow spots arranged so as to run transversely in circles around each subsegment except the 1st; this 1st subsegment bears two very characteristic marks: (1) A pink oval patch increasing in size from the prothorax to the 8th abdominal and placed subdorsally, *i.e.*, on either side of the mediodorsal line and forming two longitudinal rows, 11 in number (although that on the prothorax is modified into a linear mark on the front edge of the segment). (2) A series of yellow spots irregularly oval in form (although some incline to quadrangular) extending from abdominal segment 1 to abdominal segment 9, becoming on the latter segment a large longitudinal patch, and placed above and a little in front of the spiracle on each segment. The skin is sprinkled with minute short black shagreen-hairs, at least one in each small yellow spot, the spots being in reality hair-bases, whilst the united yellow spots are united hair-bases; there are, however, as many hairs on the dark ground colour, without pale bases, as there are on the other parts of the body; this structure suggests strongly that the rows of pink and yellow blotches on the 1st subsegments of the segments are formed by a coalesence of a number of these spots into a definite pattern. There is a very definite supraspiracular black-brown seta (iii) on the black area, and another very similar one (iv) below the spiracle on the yellow lateral flange, and one finds, dorsally, strong hairs that may represent i and ii, but they are difficult to trace and do not appear to be present on all the segments, nor to have quite the same position; there appears to be no tubercle v, unless a prespiracular seta at the front of each segment can possibly be it. The subsegments on the prothorax are ill-defined; those of the meso- and prothorax appear to consist of a wide 1st subsegment and at least 4 narrower ones, but the rows of yellow spots suggest that there may be as many as on the abdominal segments; the abdominal segments, 1st to 8th, appear to have nine subsegments, of which the 1st subsegment is small, 2nd large (half the segment), 3rd-9th* small; those of the 8th abdominal are modified by the presence of the caudal horn. The spiracles are creamy-white in colour, placed on the crease dividing the anterior subsegments; each is oval in outline formed of two lunular-shaped pieces of membrane with the straight edges closely appressed, slightly depressed centrally, with a fine, slightly-raised black rim. The prothoracic spiracle is distinctly wider than the abdominal spiracles. A subspiracular, slightly tumid, flange runs from the prothorax to the 8th abdominal segment; this is made conspicuous by the modification

* The last subsegment is very doubtfully distinct from the 8th, it appears to be so more distinctly on some segments than others.

of the front part of the flange on each segment into an oblique red stripe extending across the 1st, 2nd and 3rd subsegments of each abdominal, and by being almost continuous on the thoracic segments; each of these stripes bears, on the abdominal segments, a yellow patch directly below the spiracle, and this carries a stumpy hair, the specialised appearance of which leads one to homologise it with a subspiracular tubercle (iv). The area between the flange and venter is of the same black colour as the dorsum, and with similar yellow spots; and this characteristic mode of marking is carried almost entirely round the venter of abdominal segments 1 and 2. The remainder of the venter is reddish with a dark blackish-grey patch medially on each abdominal segment (either between, or in the position of being between, the prolegs). The prolegs are short and thick, reddish in colour, rather hollow centrally, with the outer edge forming a strong flange not very plentifully supplied with red-brown hooks; these are in pairs, alternately long and short, and 33 in number; the anal prolegs are fixed angularly against each other, and are, like the other prolegs, sparingly sprinkled with short blackish hairs. The true legs are also of a reddish colour, each with one strong black curved hook, the joints fringed with short blackish hairs (Tutt. Described from larvæ from La Grave, August 16th, 1896). We may here note that in *Hyles euphorbiae* the ovaries in the ♀ larva are yellow, the testes of the ♂ larva reddish (Bessels), whilst in the larva of *Sphinx ligustri* both ovaries and testes are white*.

Variation of larva.—We have already described certain forms of this exceedingly variable larva. At the commencement of the fifth instar, a large number of larvæ, obtained at Evolena in August, fell into three forms (*antea*, p. 221). As they neared maturity much more individual variation was noticeable, and one could safely say that when quite fullfed scarcely any two larvæ were alike. The commonest form appeared to be that in which the head, mediodorsal line, caudal horn, lateral flange, anal segment, anal prolegs, prolegs and true legs were yellow; the anterior wide (1st + 2nd) subsegment black, carrying the two yellow lateral spots on either side; the six narrow subsegments spotted, but with a yellowish lateral blotch on each side, extending the width of the last five subsegments. A somewhat rare form has this lateral series of yellow or orange-yellow blotches obliterated (or almost so) by the spotting being continued all over the segments. Others again have the black of the 1st + 2nd subsegment continued back on the succeeding subsegments with only a few pale dots on the last three subsegments of each segment. One or two have, on the other hand, the black of the 1st + 2nd subsegment spotted so much laterally as to almost lose the usual annular, or black-banded, appearance. There is, in all these, great difference in the intensity of the tint of the yellow parts, some of the larvæ having quite a deep orange mediodorsal line, lateral flange, prolegs, etc. The red form, already described (*antea*, p. 222), appears to me one of the most handsome. A few of these Evolena larvæ that Chapman brought to England were

* For the sake of those biologists who require the information, it may be well to note that Rengger, in his *Physiologische Untersuchungen über die thierische Haushaltung der Insecten* (1817), has made considerable use of *Hyles euphorbiae* for his anatomical investigations.

markedly aberrant, and more or less darkened to a degree that none exhibited when captured; it was especially to be noticed that the great yellow blotch across the small subsegments was very small or wanting, in some the small yellow spots were few, in others they crossed the space the blotch usually occupies; the white or yellow spots on the wide anterior subsegment were creamy or even red, the dorsal and lateral bands reddish, and, when the yellow spots of the small subsegments were wanting, the central hair of these seemed also to be absent or less regularly placed. In one specimen there was no lateral band, no blotch, the dorsal line very narrow and red, the white spots on the 1st subsegment small and the dots of the other subsegments very few; in all the examples the black marks on the head were very definite, although these are often wanting in typical larvæ in last stadium. Whether this variation was due to their being late specimens, or to starvation in captivity, or, what is more probable, from their not being exposed to the broiling sun which the larvæ seem to enjoy, is not very easily decided, but all became more or less dark as very few were at the time of capture. Merrifield observes (*Ent. Rec.*, xii., p. 320) that the larvæ from the Grisons vary greatly in colour and to a less degree in markings, and tend to gather into three groups: (1) The predominant colour reddish, very much the colour of red vulcanised india-rubber, the most common form. (2) With yellowish-green the prevalent colour. (3) The ground-colour mainly blackish. The conspicuous feature, in which all three agree, is the subdorsal row of large light-coloured spots, varying from white to yellow, usually cream-coloured; all the other markings, except, perhaps, the reddish colour of the dorsal line and head, &c., in most of them, go for nothing at a casual glance. Chaumette gives (*Zool.*, ix., p. 3159) the following description of the various forms of the larva found at Lausanne: (1) No triangular patches of yellow or brown along the sides; the abdomen black, or black with an interrupted ventral line of carrot-colour. (2) The two lateral series of oval shining yellow patches joined, forming a series of large oblong patches; this is spotted with much larger spots than the common form, whilst in the place of the lateral series of buff triangular patches there is a broad and continuous ferruginous longitudinal line, which is sometimes marked at the incisions by a small patch of red. (3) No triangular patches of yellow or brown, &c.; not so thickly spotted with yellow along the sides as the others; dorsal line very slender, and, in some individuals, entirely missing, its position being left in black; the oval lateral yellow patches often tinged with pink, especially the lower ones, which are sometimes quite pink; the head generally retaining the two black patches which the others only have when young; the abdomen and prolegs generally quite black, and the thoracic legs generally tipped with black, and often entirely of that colour. Buckler thus writes (*Larvae*, &c., ii., pp. 33-35) of four larvæ, which he also figured (*loc. cit.*, pl. xxiii), all in the last instar, although varying in size: "The ground-colour of the smallest was black; the next in size was blackish-green, with a multitude of small bright yellow dots, contrasted with larger spots of yellow tinged with a rosy hue in the centre," whilst, for the rest, Buckler describes one fullgrown larva, and then mentions the variations of detail in the others, as each preserved its individual points of difference to the last. "The fullgrown larva

measured from 3ins. to 3¼ins. in length, and was, in proportion, a trifle more slender than the larva of *D. gallii*, though otherwise similar in form, being plump and cylindrical, tapering considerably from the 4th segment to the head, which is the smallest segment, and is rounded in outline, tapering a little also at the two hinder segments, the 12th having a rough, blunt-tipped horn, curving a little backwards; each segment from the 5th to the 12th is subdivided into seven rings by well-defined wrinkles, the front ring being equal in width to three or four of the others. The skin was generally smooth and shining; the anal prolegs larger than the ventral prolegs and of a squarish form; the segments appeared more plump and swelling on the ventral than on the dorsal surface. As to colour, no two individuals were of the same type, the ground-colour of the skin only varying in intensity from a bronze-green to a deeper blackish-bronze. The head was blood-red, the mouth and base of papillæ pale yellow, the former margined above and below, and the latter surrounded, with black; the dorsal stripe was blood-red in colour, widening on the second segment in a curve down either side, suggestive of a plate, but thence continuing of nearly uniform width to the anal flap, which was likewise red. The horn was of the same colour, but glistening, and with the tip black. In these larvæ the subdorsal region bore a row of very blunt wedge-shaped red marks, widest at the hinder part, and pointing forwards, and a row of large roundish or dumpy pear-shaped bright ochreous-yellow spots slightly tinged above with pink (on the 12th segment of a longer pear-shape, with the stem pointing to the horn); below these was another similar row, only paler and irregular in shape from a fold in the skin, these spots, on each broad front ring, being much surrounded with black; below these were a few small white dots, and then the whitish oval spiracle; the narrower hinder rings of each segment—whether in the red wedges or on the ground-colour—bore transverse rows of thickly-set yellow dots; the puffed region below the spiracles showed red interruptedly, but without any dots; beneath this was a patch of the dark ground colour sprinkled with white dots; the tips of the ventral and anal prolegs were blood-red; the anterior legs were orange-ochreous tipped with black. Two striking aberrations occur: (1) The form which may be termed the red variety, from the great quantity of this colour which it possessed, and which had the first or broad ring of each segment of a black ground-colour, and the narrow rings of a bronzy-green; the wedge shapes of red in the subdorsal region extended along each segment from their greatest breadth at the last ring to the blunt apex close to the broad front ring; the dots of yellow above and whitish below, and the double series of large spots were as described above; all the rings were abruptly interrupted by the inflated and rather tortuous broad subspiracular region coloured red; below this, on each segment, came a pear-shaped patch of bronzy-green dotted with white; all the rest of the belly and legs were red, but inclining at the segmental divisions to deep ochreous or greenish-ochreous, as the above-mentioned red wedge marks also did at the same place. There were a few yellow dots at the segmental divisions in the subspiracular region; the black plate on the second segment

was margined with red; the red head and the dorsal stripe, &c., were as in the other varieties. (2) The black variety had no subdorsal wedge marks; the first ring in each segment had a black ground, the others a greenish-black ground, dotted and spotted with bright sulphur-yellow above and white below; very little of the spiracular region was inflated, it was coloured crimson-red and ochreous, the red in the middle gently blending with the ochreous at each segmental division; the anterior edge of the second segment was yellow; a large round black spot on the top of each lobe of the crimson head. The anterior half of the anal prolegs was black, the rest crimson; the crimson dorsal stripe quite narrow; the anal flap was black, margined with crimson. Buckler also describes a variety of this larva, brought home in spirits from Cairo, by Jenner-Fust, which he received in May, 1871, and figured. This had the broad ring of each segment black, the ground colour of the other rings of the deepest blackish-olive; the head, the plate on the second segment, the dorsal stripe, the legs, anal flap, and caudal horn were blood-red. The double series of large spots was creamy-whitish; the upper rows of small dots pale yellow, the lower rows white; the subdorsal truncated-wedge shapes were of deep ochreous and largely developed; the inflated subspiracular region, belly and ventral prolegs, of deep ochreous or buff colour, the latter tipped with red; a pear-shaped blotch of dark olive dotted with white was situated below the subspiracular region on each segment; the anterior legs red. Harrison notes (*Ent. Rec.*, ix., p. 293): "The changes in colour that many larvæ undergo in the final stadium are as follows—The red dorsal stripe turns yellow, then black; the subdorsal and supraspiracular spots undergoing the same changes in turn. Then the caudal horn, head and legs, become blackened (without, however, turning yellow). In the very black forms, the supraspiracular spots almost cease to exist, and the subdorsal are only visible because of their brighter surface. About seventy larvæ underwent the above changes, and these must have been quite normal, and not due to disease, for the larvæ continued to eat most ravenously, and out of about eighty larvæ, which did not go down at once, only five were lost." Réaumur notes (*Mémoires*, i., pp. 289-291) that, when the larva is young or has just changed its skin, its colours are more delicate than at other periods, and immediately after a moult there is less black, whilst a delicate green tint, with some little yellow, prevails. Later, when the colours are fixed, it is blacker; it also has yellow where it will be red, and white where it will be yellow when the larva is more mature, the yellow becoming first tinged with red, and then red, and the white takes a yellow tint and then becomes yellow. There are larvæ that have only the little dots yellow, all the larger ones being red—either rose-coloured or of some deeper tint. When about to pupate the larvæ change colour, becoming dirty brown and having only some whitish spots. Weismann says (*Studies in the Theory of Descent*, pp. 206-207): "In the last stage the dorsal line is sometimes black and sometimes red, or, again, this colour interrupted with black, so that only small red spots mark its course. The head may be entirely red, or this colour mixed with black. On the underside

of the larva, red generally predominates, but, in some specimens, this is replaced by black. The ground-colour is also variable, being generally a shining brownish-black, but sometimes dull coal-black. The shagreen dots are sometimes white and sometimes yellow, and the "mirrors" of the ringspots are also often yellowish. In many specimens from Kaiserstuhl, the red was unusually vivid, and was not limited to the ordinary places, but occupied also the triangles on the posterior edges of the segments (fig. 44), which are green in the 3rd and 4th stages (fig. 42). This form has also been figured by Hübner. In one individual (fig. 43) the under ringspots were wanting, whilst the upper ones possessed a beautiful red nucleus, fading away anteriorly and showing the first step in the formation of a complete eyespot." Caradja's observation that, in Roumania, the summer larvæ are of light colour, but those which appear in autumn always extraordinarily dark, is interesting. In opposition to the usually accepted view, the same author makes the noteworthy observation that the lightest larvæ mostly produced darker, often red-tinted, moths, the darkest always light specimens only. Bartel notes *(Pal. Gross-Schmett.*, ii., p. 80) that, "in Sicily, the larvæ of this species are of a brighter green colour than in Central Europe. The black colour which, in general, characterises the full-grown larvæ of the latter locality, disappears almost entirely. The large yellow spots on the sides are filled in with white, and the yellow line over the legs is unicolorous and entirely without admixture of red. In Spain and other localities of southern Europe (also in western Asia and in Algeria) almost entirely bright yellow coloured larvæ occur ; the head of these is red, but they produce only the ordinary form of the moth. Larvæ from the eastern Pyrenees form in their markings a transition from the ordinary *D. euphorbiae* larvæ to those of *D. nicaea*." Lederer records larvæ from Amasia and Tokat as being exceptionally pale. Eaton observes that the adolescent larvæ, exceedingly abundant at Biskra, do not present any variation in colour, only that some have the dorsal line red, others yellow. Sich says that the larvæ become somewhat duller when fullfed and at the time that they are wandering about for a place for pupation.

Development of larval markings.—*First instar:* The young larvæ *(Studies in Theory of Descent*, pl. v., fig. 37), immediately after hatching, measure 4mm.; they are at first rather light, but, in the course of half-an-hour, they are seen by the naked eye to become of a deep velvety-black ; later, on increasing in size, they again become paler, appearing of a greenish-black, and subsequently blackish-green. On further increasing in size (fig. 38) they are blackish-green, with the horn, head, legs, and a crescent-shaped chitinous plate on the back of the prothorax black. There are also, on the last segment, a double and two single black chitinous plates. Of the later marking of the caterpillar there is scarcely anything present. The spiracles appear as white spots, and, on each segment, there are a number (usually 10) of small warts, each of which emits a single bristle. When the young larvæ have attained a length of 7mm. they are olive-green, and do not contrast so brilliantly with the green of the *Euphorbia* leaves as before, neither do they as yet possess any markings. *Second instar:* The

first ecdysis occurs after five days, and with this there appears quite suddenly a very complicated pattern. The ground-colour is now a light yellowish-green (fig. 39), and, on each of the 12 segments, near the front border, there is a pure white round spot in the middle of a large black transverse spot. These are designated as the white "mirrors" on black "ground-areas," both together constituting "ring-spots," as distinguished from "eye-spots" proper, in which a "nucleus," the pupil of the eye, is also added. In many, but not in all, specimens, very distinct traces of a subdorsal line can be seen as a light whitish stripe connecting the white spots. The horn, the thoracic legs, prolegs, and some spots on the head are black. The larvæ remain unaltered till after 4 days, when, having a length of 17mm., the second moult takes place, bringing with it changes quite as great as those which occurred with the first. *Third instar:* The larva now assumes the shagreened appearance which it possesses in the adult stage. Small white warts are arranged in rows from the dorsal to the spiracular line, and again, underneath this line, on the abdominal legs. These dots are not only of value as a character for differentiating Deilephilid from Chœrocampid larvæ, but they also play a part in the peculiar spot-marking, which will be shown later on. The ground-colour of the larva is now light-green (fig. 40), replaced by black on certain parts. From the black "ground-area" of the ring-spots, two black triangles extend towards the posterior borders of the segments, but usually without reaching them. The ring-spots are not essentially changed, although it may be observed that, in most specimens, the shagreen dots under each ring-spot are somewhat larger and stand closer together than in other places. In the following stage they become fused into a second white "mirror," so that two ring-spots stand one above the other, their black ground-areas meeting. The formation of the second ring-spot sometimes takes place in the present stage (fig. 42). The subdorsal line has now completely vanished, whilst the infraspiracular line appears as a broad stripe above the legs. The horn is yellow with a black point, and the black spots on the head have increased in size. *Fourth instar:* The third moult, which again occurs after 4 days, is not accompanied by such important changes. The green ground-colour has now completely disappeared, and is replaced by a dull black. The larvæ are now, as also in the previous stage, extremely variable. Thus, for example, a triangular patch of the green ground-colour may be retained on the posterior edge of the segments (fig. 41), those specimens which possess this character generally having their markings retarded in development, as shown by the absence of the second "mirror" of the ring-spots. In fig. 41, the shagreen-dots, from which this second mirror is subsequently formed, are distinctly larger than the others, and, on the 11th segment, two of them have already coalesced. *Fifth instar:* After another period of four days, the fourth moult takes place. The marking remains the same, but the colours become more vivid, the brick-red of the head, horn, dorsal line and legs changing into a fiery-red. The infraspiracular line, formerly green alternating with yellow, generally becomes resolved into a row of reddish-yellow spots. Ten days later the larva (8·5cm. in length) ceases to feed and prepares for pupation. In this last stage

also there is great variability of colour, but, although each particular character is subject to fluctuation, the individuals of the same brood show but little variation among themselves.* . . . I cannot assert that a fifth moult occurs in the last 10 days, although I am very doubtful whether this is the case. It is certain, however, that some time before pupation. and whilst the larva is still feeding, the striking colours fade out, and become replaced chiefly by black. The ontogeny of this species is obviously but a very incomplete representation of its phyletic development. This is at once apparent from the large gap between the 1st and 2nd stages. It is not possible that a row of ring-spots can have arisen suddenly; in all probability they have been developed from a subdorsal line which, in *euphorbiae*, is now only indicated in the second stage by a faint line. This conjecture is raised to a certainty when we call in the aid of the larvæ of the remaining Deilephilid species (Weismann, *Studies in Theory of Descent*, pp. 202—207).

Cocoon.—The cocoons are of a very firm texture, spun with strong and coarse silk threads attached to some leaves of spurge above, and with some sand interwoven, and, in each instance, firmly fastened to the side of the pot in which the larvæ have been placed, and sunk about ½in. below the surface of the sand, so as to be immovable, though the sand was loose. The interior of the cocoons beautifully smooth, with fine silken lining (Buckler). The larvæ make a hole about ½in. deep, "roofing" and "walling" it with silk, mixed with sand, bits of leaves, etc., but without making a distinct floor. They remain in the cocoons about a week before turning to pupæ. In spite of the normal habit of the larva to make its cocoon partially underground, many individuals made up their cocoons on the surface among leaves (when earth was not available), the silk used being dark yellow in tint (Harrison). When fullfed the larva enters the ground in which it makes a cocoon in which to pupate (Réaumur). Cocoons are sometimes found in nature in Malta, among rubbish on the ground, the larvæ spinning the materials tightly together (Mathew); larvæ pupate on the surface of the ground either free or in a loose cocoon (Bartel). The larvæ pupate under moss, &c., placed in the breeding-cage, and choose the darkest places that can be found (Sich). Thirteen larvæ formed loose cocoons in sand (Fry). The larvæ pupate in the sand, forming a loose case of earth around them (Curtis). The cocoons are found just below the surface of the ground (Johnson).

Pupa.—The pupæ of *Hyles euphorbiae* and *Celerio gallii* are extremely similar. As compared with our other British species, they agree with *Theretra porcellus* and *Eumorpha elpenor*, in general outline and in the anterior position of the labrum, more than with any others. They are, however, less specialised than those of *T. porcellus*, *E. elpenor*, &c., in so far that the latter has an appreciable keel to the maxillæ, whilst in *H. euphorbiae* the head extremity of the pupa is fairly rounded on all aspects, and, in fact, except that the

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*Upon this fact obviously depends the statement of that extremely accurate observer Roesel, that the larva of *euphorbiae* is but very slightly variable (*Insektenbelustigungen*, iii., p. 36). I formerly held the same opinion, till I convinced myself that this species is very constant in some localities but very variable in others. It appears that local influences make the larva variable (Weismann).

labrum is definitely anterior, the maxilla has undergone no further development. Nor are there any rough ridges on the abdominal segments as in the pupa of *E. elpenor*. In its general outline, the pupa is an ordinary obtect pupa, slightly flattened from back to front, and carrying its full thickness right up to the prothorax, and, with slight diminution, to the 7th abdominal segment, the 6th and 7th do, indeed, diminish appreciably, but the three following segments diminish in a rapid cone. There is hardly any curvature in the pupa, it might be called straight. The anterior extremity is nearer the venter than the dorsum, the rounding being chiefly dorsal and the anal spike is on the dorsal edge of the otherwise somewhat truncate extremity. The measurements of an individual selected at random are:

MEASUREMENTS AT	FROM HEAD (LABRUM) AT	TRANSVERSE DIAMETER AT	ANTERO-POSTERIOR DIAMETER AT
Mid prothorax	3·0mm.	8·0mm.	8·0mm.
Front mesothorax	5·5 ,,	9·0 ,,	10·0 ,,
Hind margin mesothorax	11·0 ,,	10·0 ,,	10·0 ,,
End of 1st leg	13·0 ,,		
End of antenna	14·0 ,,		
Widest part 4th abdominal	20·0 ,,	11·0 ,,	10·0 ,,
End of maxillæ..	21·0 ,,		
Widest part 5th abdominal	24·0 ,,	10·0 ,,	9·5 ,,
End of 7th abdominal..	32·0 ,,	8·0 ,,	7·5 ,,
End of 9th abdominal..	34·5 ,,	2·0 ,,	2·0 ,,
Base of spike	35·0 ,,	2·0 ,,	1·0 ,,
Total length	36·5*,,		

The glazed eye points (by its convexity) directly forwards. The first spiracular opening is a narrow slit directed forwards. The posterior lip being comparatively wide and lying flat, passes forward over the anterior one; it is dark in colour. The other spiracles are dark, an oval depression with the transverse opening axially surrounded by a fine raised lip. The prolegs are depressions, centrally smoother, with radial impressed lines. The cicatrix of horn on dorsum of 8th abdominal is slightly raised with the sculpturing radiating from it in fine ridges, just behind it is a depression, which looks like, and doubtless is, the result of the pressure of the base of the larval horn, when depressed backwards on the pupal skin, just before the pupal moult, not recovered from before the hardening of the pupal cuticle. A suture is visible down the prothorax, and a false one down the mesothorax, *i.e.*, there is a dorsal line or ridge so placed as to give a white line. The sides of the anal groove are full, but do not amount to bosses or tubercles, the anal spike is roughly wrinkled dorsally, ventrally it is longitudinally wrinkled for the basal, smooth for the terminal, half. At the wing-bases some specimens have small brown points raised above the general surface, generally in one or more groups of two each; sometimes similar points occur, symmetrically on the wings. Others are quite without them. There are no other special marks, tubercles, &c., even the

* A large specimen may reach 50mm. when stretched out (Chapman).

labrum and angles of the epicranium are quite flat, just marked out and no more. The surface sculpturing is of labyrinthine wrinkling over the head, thorax and appendages, becoming, on the abdominal dorsum, an arrangement of pits. Over the head and pro- and mesothorax, the aspect is much that of cerebral convolutions, the summits being pale, the sulci dark; over the appendages the sulci are more nearly transverse, and fairly regular over the antennæ. Poulton's line is well-marked, but the neuration, which looks obvious at a rough glance, is marked only by a longitudinal arrangement of some of the sulci of the wrinkling. On the abdominal segments the pits tend to run together into sulci, and this is marked in certain transverse lines, apparently indicating sub-segmentation, but varying in clearness to a great degree in different specimens. Two lines are usually seen in each segment, the first $\frac{2}{5}$ and the 2nd $\frac{4}{5}$ from the anterior margin of the segment, sometimes presenting two distinct black lines; on the 2nd and 3rd abdominals the posterior element, instead of being only $\frac{1}{5}$ of the segment, or, being really $\frac{1}{5}$ of the segment, has behind it a very definite similar element that might be intersegmental membrane fixed. The 7th abdominal segment has a broad rounded posterior margin, as if the 8th segment, being considerably smaller, had been well telescoped into it. The one structural point by which it is clearly separable from the pupa of *C. gallii* is the sculpturing of the prespiracular areas of the 5th and 6th abdominal segments; on segment 5 this area is not punctured, but the ridges rise into a series of sharp edges, transverse to the segment, and, here, the ordinary rule of colouring is reversed, the sharp edges being dark and the rest of the area paler (everywhere else the ridges are rounded). On abdominal segment 6, the ordinary sculpture prevails; there is, perhaps, one little ridge close to the spiracle. Another point of difference with *C. gallii* is in colouring, but this is so much a matter of degree that one may doubt its holding good in all cases. The colour is a pale terra-cotta, varied with more or less black, which is sometimes confined to the sulci and pits, but sometimes invades the general surface, and a more or less ruddy tone, or a brown is sometimes evident on the abdominal surface. Usually, the wings are palest, occasionally they are darkest, and similar variations prevent any general description as to the distribution of colour. The character of the general wrinkling is much smoother in *H. euphorbiae*, as if rubbed down and polished, the sulci being very narrow in comparison (see *anteà*, pp. 188-189, "Pupa of *C. gallii*"). To distinguish the two pupæ (if together for comparison) it suffices to pass the finger over the mesothorax, when *C. gallii* gives a sensation of roughness in comparison with the polish of *H. euphorbiae* (Chapman). Long and slender, very like that of a Sphingid *(sens. strict.)* in general outline, except for the maxillary protuberance. Head, wings and appendages of a dull ochreous-grey but with a slight greenish tinge; the skin rugose; the abdominal segments transversely subdivided, brown, the 7th and following segments being darker as also is the smooth skin of the incisions between 4-5, 5-6 and 6-7; a dark mediodorsal shade runs down the centre of abdominal segments; on ventral surface of the 5th, 6th and 7th abdominals a narrow median longitudinal fissure, and traces of the position of the larval prolegs; the cremastral horn moderately long, black-tipped, and bluntly bifid. The

frontal headpiece large, the antennæ thickened towards the base extending about halfway along the costa of wings; the maxillæ wide at base terminating at apices of wings; two pairs of legs end opposite tips of antennæ. The glazed eye, extending from base of 1st leg to base of antenna not very conspicuous. The pro- and mesothorax well-developed, the metathorax very restricted. The prothoracic spiracle is a conspicuous depression on the line separating the pro- and mesothorax; the 1st abdominal spiracle just traceable, those on the 2nd-7th abdominal segments forming narrow transverse slits with conspicuous black rings, that on the 8th abdominal segment inconspicuous and closed. The genital organs conspicuous on the 8th abdominal segment (Tutt. Described September 21st, 1899). Poulton figures and describes (*Ext. Morph. Lep. Pupa*, p. 205, pl. xx., figs. 22-23) the terminal abdominal segments of the pupa of this species. Fig. 22 represents the last three segments of a male pupa, seen from the right side, natural size. The rudimentary spiracle and the scar of the caudal horn are seen on the 8th abdominal segment. The horizontal furrow which divides the 10th abdominal into a dorsal (rostral) and ventral (anal) part is unusually distinct. The division is rendered especially apparent because the dorsal part extends further anteriorly than the ventral, so that the 9th abdominal is narrow in front of the former and becomes suddenly broader in front of the latter. Fig. 23 (× 26) shows the median ventral area of the 9th and adjacent parts of the 8th and 10th abdominal segments, showing the ♂ organ and the sculpture of the surface very distinctly. The ♂ organ is somewhat asymmetrical. The two tubercles in front of it are probably an individual peculiarity. Buckler writes: "The pupa is $1\frac{5}{8}$ins. in length, $\frac{1}{2}$in. in diameter, tapering a little from the thorax to the frontal extremity, where it is rather smooth; the wing-cases pressed close to the body; the abdominal rings in tolerable relief; the outline tapered a little near the anal tip, which ends in a broad, flattish, downwards-curved spike, pointed at its extremity. The colour of a dingy, deep brick-red above, fading a little beneath to more of a flesh colour, and thickly covered with minute blackish punctures; the wing-covers dark brownish, much freckled and finely streaked with blackish, as also are the head, antenna-, eye- and leg-cases, as well as the trunk-case; the segmental divisions of the abdomen dull purplish-red, and quite smooth, while the parts between them are roughened by black pits or punctures on a rather shining ground; a dorsal line of the ground colour visible on the back of the thorax. The spiracles black."

Comparison of pupæ of Celerio gallii and Hyles euphorbiæ.—Taking the examples of *C. gallii* before me, which may or may not be typical, it is very difficult to find any definite distinction between the pupæ of *C. gallii* and *H. euphorbiae*. The one definite point is that the peculiar sculpturing in front of the spiracles which, in the pupa of *H. euphorbiae*, is practically confined to abdominal segment 5, in that of *C. gallii* affects also abdominal segment 6 and quite appreciably segment 7. It is on a more definitely marked off separate area, and is slightly different in character, the ridges being rather closer and in more continuous lines, and with a more abundant supply of paler colouring, *i.e.*, more ruddy, less black. The general colouring of the pupa is darker

and redder (on the average). The front of *H. euphorbiae* is comparatively smooth and rounded, with no tendency to spines or tubercles. The pupa of *C. gallii* may be about as smooth, but there are often distinct frontal spines (epiclypeal) beside the labrum, and fainter ones on the summit of the head. The summits of the wrinklings (cerebral convolutions) vary in height, or appear to do so, and the pupa feels rougher, apparently this is due to the wrinkles in the pupa of *H. euphorbiae* having flat tops and very narrow perpendicular-sided valleys between, whilst in that of *C. gallii* the valleys are wider and more open and the ridges consequently narrower. On the abdominal segments, pitting does not so soon or so completely replace wrinkling, so that, on the 4th abdominal segment, it is doubtful whether it would be easier to describe the sculpturing in terms of wrinkling or pitting. In the described specimen of *H. euphorbiae* the antenna reached further than the first leg. This is not always the case but sometimes the antenna reaches even further than in that specimen. Apparently the antenna tends to pass the leg more frequently and fully in *C. gallii* than in *H. euphorbiae*. The anal spine varies as in *H. euphorbiae*, in some being very fine and sharp, in others short and blunt, some present distinct evidence of a bifid tip, but *H. euphorbiae* does so also. In size, the pupa of *C. gallii* averages somewhat smaller. It is also possible that *C. gallii* is a little more flattened dorsally and tapers a little more gradually behind, but, if so, the difference is very slight in either case, and individuals vary more than the average difference covers (Chapman).

Duration of pupal stage.—It seems almost impossible to accept Mazzola's statement, referred to by Treitschke (*Die Schmett.*, x., p. 131) that he had an example that emerged after being 5 years in the pupal stage, but our own records show that the pupal stage may be anything from 15 days to 15 months. Curtis states (on Raddon's authority) that the pupal stage sometimes extends to a second year, and hints that the shifting of the sand on coast sandhills covers up pupæ for a great length of time, that they lie hidden and alive, and that the moths do not emerge until brought to light and life by the influence of the elements ! ! Mathew's tabulation (*anteà*, p. 216), also, is most interesting from this standpoint. Of four larvæ taken in Capri, in May, 1866, and that pupated at about the same time, one was only in the pupal stage about 3 weeks, the imago emerging in June, the others at long-distant intervals, the last not appearing until October (White); at Munich some emerge in late autumn of the year of pupation, others not till after a second winter or even later (Kranz); of six larvæ taken at Ingolstadt on August 2nd, 1892, four pupated August 6th-8th, and one imago emerged August 20th, having been only 12 days in the pupal stage (Strohmayer, *Soc. Ent.*, vii., p. 142). The pupal stage in Sicily, in the summer, usually lasts only three weeks (Bartel); in Upper Austria the pupal period varies, in 1897 an imago was bred from a pupa 19 days old, but sometimes the pupal stage goes over two winters (Himsl). In the Bilbao district, larvæ that pupate in August frequently produce imagines in October (Rössler).

Stridulation of pupa.—Pupæ moistened, and when placed in water heard to hiss, sound repeated several times, and resembled that of a snake (Weir, *Ent.*, xiii., p. 218)

Forcing pupæ.—This pupa lends itself readily to the forcing process and imagines can thus be produced throughout the winter; 20 pupæ placed in incubator with evaporating water, on January 10th, 1884, and subjected to a temperature fluctuating between 27° C and 30° C all emerged between January 28th and February 21st, 1884 (Weismann); three pupæ placed in forcing-box October 21st, 1872, placed box at first on iron plate of a kitchen stove over boiler where the situation was warm through the greater part of the night and quite hot by day, when the bottom of the box was elevated two inches above the hot plate by the aid of two strips of wood on which the box rested; here they were damped with lukewarm water twice a day. On the 23rd of November a fine and perfect moth came from the earliest pupa, but after that my efforts were baffled; the two remaining pupæ continued lively but the moths would not appear. I moved the box to a place before my sitting-room fire, but without effect, and, at last, I came to the conclusion that I ought not to have begun the forcing till the weather had become dry and frosty, and that then the heat would have had due effect, but as it was, the great humidity of the atmosphere had prevented this, and sufficient heat had not reached the pupæ to develop the imago in them at once. After continuing my forcing till the end of December, I put the pupæ aside to wait for summer, but before that time came they had died (Buckler). We have more than once placed pupæ of this species on moss in flower-pots on a kitchen mantel-piece in January and moistened the moss slightly every day; few of the pupæ resist this treatment more than 5-6 weeks before giving up their imagines.

Foodplants.—*Euphorbia*, [*Galium*]* (Linné), *Euphorbia cyparissias* (John), *E. amygdaloides* (A. H. Jones), *Euphorbia peplus*, *E. portlandica* (Buckler), *E. paralias* (Harrison), *E. esula* (Glitz), *Tithymalus helioscopius*, *T. gerardiana*, *Fuchsia* (Bartel), *E. piscatoria* (Longstaff), *E. guyoniana* (Eaton), *E. dendroides*, *E. pinea* (Galvagni), *E. wulfenii* (Garbowski), *Euphorbia exigua*, preferring slightly withered leaves (Sich), particularly fond of the milky juice of the *Euphorbia* (White), vine leaves (Berthelin, *Bull. Soc. Ent. Fr.*, 1881, p. clvii), [oak (Scheffler)]. There is some suggestion of "gastric education" in the species, *e.g.*, Garbowski notes larvæ as eating *Euphorbia cyparissias* but refusing *E. peplus* and other *Euphorbiaceae.* Robson records (*Young Nat.*, ii., p. 310) *E. peplus* being preferred to *E. amygdaloides* and *E. esula.* He adds (*teste* Millar) that the larvæ will eat dandelion, on which, however, they do not thrive. Unterberger fed the larvæ on lettuce (*Ill. Zeits. für Ent.*, iii., p. 232). Laubenheimer has (*Ber. Oberhess. Ges.*, vi., p. 82 [1857]) a short note on the foodplant of this species which, he says, is rare at Giessen on account of the absence of its natural foodplant, although occasional larvæ have been met with on the species of *Euphorbia* growing in the Botanical Gardens. He asserts that no other foodplants but species of *Euphorbia* are known, and Esper has expressly mentioned that he repeatedly tried to induce them to take substitutes, but failed; Laubenheimer thinks it,

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* Linné's references (see *anteà*, p. 202) show that he had mixed up *euphorbiae* and *gallii* under the former name. Undoubtedly this foodplant "*Galium*" resulted from referring De Geer's species (*gallii*) to *euphorbiae.*

therefore, worth recording that, on August 31st, 1856, he found eight nearly fullgrown larvæ on *Polygonum aviculare* near the Badenburg, and fed them up successfully upon this plant, which they seemed to prefer to the *Euphorbia peplus* that he also offered them.

PARASITES.—*Microgaster nigriventris*, Nees (Rodani). Bartel notes (*Pal. Gross-Schmett.*, ii., p. 81) that the larvæ are frequently attacked by hymenopterous and dipterous parasites. The larvæ are also sometimes affected by *Filariae*.

HYLES EUPHORBIÆ AS A BRITISH INSECT.—Moses Harris, in the *Aurelian*, in 1778, introduced this species as British, on the strength of a larva taken on marshy ground at Barnscray, near Crayford in Kent. He figured the pupa and imago (*loc. cit.*, pl. 44) from Belisle, in France, with the larva of *C. gallii*, presumably also from a foreign example, as the larva he obtained at Barnscray refused to eat and died a day or two after capture. His description of the larva that he captured is certainly not that of *H. euphorbiae*. Donovan gives (*Brit. Ins.*, iii., p. 51, pl. 91-92) excellent figures of the imago and larva of the species, and notes that these are not from British examples. He further observes that Drury had given a figure of the species among his rare insects, but as a native of a foreign country. Donovan himself bases the British authenticity of *H. euphorbiae* on a damaged imago stated to have been taken at Bath, and four larvæ taken in Devonshire, in 1793, by Curtis. Haworth simply writes (*Lep. Brit.*, p. 61): "Habitat in Devonia. Larva on *Euphorbia*," but in *Trans. Ent. Soc. Lond.*, 1807, pl. iv, he figures a specimen of *H. euphorbiae* under the name of *Sphinx galii*. Curtis (*Brit. Ent.*, v., fo. 3), in 1823, and Stephens (*Illus.*, i., p. 125), in 1828, give details of Raddon's captures in Devon, Raddon himself, in 1834, publishing (*Ent. Mag.*, ii., pp. 535-536) the particulars of obtaining this species. He observes that, in the autumn of 1806, he visited north Devon and, whilst at the village of Instow (opposite Appledore), the first larva was brought him by a fisherman. This was forwarded to Füesli, who considered it to be the larva of *Sphinx koechlini* (=*livornica*). Between 1806 and 1819 the larvæ were very plentiful, and this was especially the case in 1814, when, after a day's search in which only fullfed larvæ were taken, Raddon gathered an armful of spurge for food, placed it in water on his arrival home, and, in the morning, found the plants covered with not less than a hundred minute larvæ only a day or two old. Füesli, Leach and others, to whom pupæ were given, appear not to have been very successful in getting imagines from them. A collector named Cocks is noted by Raddon as getting a fullfed larva on October 3rd, 1834*, which changed at once to a pupa that was sent on to Raddon. The species from this date apparently ceased to have any British habitat. Isolated records of possible immigrant or escaped imagines occur occasionally until 1872, when two imagines were exhibited at the meeting of the Entomological Society of London on September 17th, 1873, one a remarkable aberration, said to have been bred from near Harwich from

* This was one of the *C. gallii* years (see *anteà*, p. 195), and this particular larva may possibly have been referable to this species.

larvæ taken with several others in June, 1872, by a man named Durand (*Ent.*, vii., p. 46, ix., p. 263), but, besides the great improbability of June larvæ being found in this country, other circumstances led to disbelief in the British origin of these examples. In 1889 and 1890 St. John published (*Ent.*, xxiii., pp. 18, 319) a somewhat vague account of the capture of larvæ in Cornwall, supplemented, and certain inaccuracies corrected, later by Fry*, the captor, who observes (*loc. cit.*, xxvi., pp. 315-316) that he took, in August, 1889, 18 or 19 larvæ about two miles from Newquay in Cornwall, and that of these 5 or 6 died, 13 formed cocoons, of which one was given to a schoolfellow, and 12 to St. John to rear, three of these were reported dead, nine were said to have emerged, of which one went to Hanbury's collection, three to St. John's collection, and five were at the time in Fry's collection. With the exception of this record, there has been no real evidence of the species being sedentary in these islands for more than half a century, and with the exception of the larva found by Cocks in 1834, for above threequarters of a century.

Habits.—The imagines appear to be strictly crepuscular in their flight, feeding on the wing from about 6.30 p.m. to 9.15 p.m., settling down before 10 p.m., clinging firmly to their resting-place, and usually remaining in the same position all night. The males poise themselves on the wing, sometimes making use of one or two legs to steady themselves whilst hovering at the flowers, although, usually, the legs hang straight down. When the tongue is inserted in a flower it is often bent at almost a right angle, being nearly straight for the first half of its length and then taking a sudden bend downwards to the flower, the thorax of the moth being nearly always above and over the top of the flower and nearly perpendicular to it. A moth will sometimes remain at the same flower for 2 or 3 minutes. Whilst hovering, the humming of the wings is distinctly audible, and if, at this time, a moth be observed in profile with the base of the nearer pair of wings on the same level as the eye of the spectator, the underside of the wings alone can be observed as though the wings, while vibrating, only passed through an arc of 45° on either side of the perpendicular. The females appear to fly but little compared with the males. The imagines are noted as living in confinement from 10—14 days. There seems to be no fixed time at which they emerge—wings of one expanded and dry by 8.15 p.m., another 10.30 p.m., two others before 8 a.m., one before 6 a.m. (Sich). Their general habit, in nature, is to fly at dusk at flowers—at verbenas (Barrett), at *Saponaria officinalis* (Jäger), prefer well-scented flowers especially *Echium* and *Phlox* (Bartel)—although Rühl notes that they fly whilst it is still light and continue to do so for some half-hour, until dusk, at Biedenkopf, from about July 7th-26th. That occasional wanderers should be taken in Britain is not at all surprising, for Mathew says (*in litt.*) that one was brought to him by a blue-jacket,

* St. John's statement *re* these does not agree with that of Fry. The former reports: Thirteen nearly fullfed larvæ taken, three died in pupation, ten healthy pupæ resulted, and imagines emerged—♂ May 5th, ♂ May 9th, ♂ May 13th, ♀ May 31st, ♂ June 6th, ♂ June 16th, ♀ June 22nd, ♀ July 24th 1890. One pupa died, one was still alive September, 1890 (*Ent.*, xxiii., pp. 18, 319; *Ent. Rec.*, iv., pp. 249, 297).

found on board ship when off the coast of Malta as early as April 14th, and he further states that they were seen flying around the electric lights of the ship off Cyprus, Corfu and Crete in June, 1898, whenever the lights were burning. He states that the imagines are evidently on the move for a considerable time during the night for he has seen them flying to the electric light from soon after sunset until past midnight, whilst by day, in Malta, they may be seen occasionally resting on walls and posts, but most of them probably hide under stones in the stone-walls; very abundant at light at Aix-les-Bains, in July, 1896 (Agassiz), common at electric light at Davos-Platz, &c. (Sellon), at electric light at Berne, June 21st, 1893 (Hiltbold), also in August from 1893-1895 at Zürich (Nägeli), at electric light, July 3rd-4th, 1898, at Aigle, from 9.15 p.m.-10.20 p.m. (larvæ occurring in all stages at same time in the district) (Lowe), also at Zermatt, from August 15th-19th, 1898 (Jones), Steinert says that *H. euphorbiae* (like *Hyloicus pinastri*, *Eumorpha elpenor* and *Theretra porcellus*) sometimes comes to sugar (*Iris*, v., p. 397).

Habitat.—Much doubt still exists as to whether this species has ever been really indigenous in Britain. Raddon, as we have already noted, records (*Ent. Mag.*, ii., pp. 535-536) that, from 1806-1819, he took many larvæ on the sandhills at Braunton and Appledore, which pupated in due course, and imagines from which are to be found in British cabinets, whilst Fry has stated that, in August, 1889, he took 18 or 19 larvæ in a little sandy bay at the foot of the cliff, about 2 miles away from Newquay, in Cornwall (*Ent.*, xxvi., pp. 315-316). More evidence is required as to the larvæ reported as taken on the coast near Harwich in June, 1872 (*Ent.*, vii., p. 46; ix., p. 263). The species has no other standing in the British fauna, except for odd examples taken here and there in different parts of the country, evident wanderers from the continent or escapes from confinement* (hundreds of imagines have been for three-quarters of a century annually reared from pupæ in Britain), and which have no real bearing on the scientific aspects of "habitat" or "distribution." Abroad, where the species sometimes swarms, its habitats are exceedingly varied. From the sea-level on either side of the Mediterranean coast, and the shores of the Atlantic as far north as Brittany, Holland and Denmark, the species spreads inland, being particularly abundant in warm valleys of the Pyrenees and the Alps of central Europe to a considerable elevation. It extends to the east well into Asia, occurring on the arid sandy steppes of the Ural district, Persia, and Turkestan, whilst, in the Kouldja district, it is said to be abundant in gardens throughout the whole of the summer. Harrison says that, on the coast sandhills of Brittany (*e.g.*, at Le Poldu), it is exceedingly common, whilst Oberthür notes that in La Manche, Ille-et-Vilaine, and Côtes-du-Nord the species is abundant in, but never found outside of, the maritime zone, abounding in some places on the sandhills quite close to the sea, but it also goes up the rivers, *e.g.*, the banks of the Loire between Blois and Langés

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* See *Ent. Rec.*, xv., p. 67. We ourselves have frequently set free imagines of rare species, reared from foreign pupæ for which we had no further use. Two living examples of *H. euphorbiae* have come into our own hands; we have no doubt that these were "escapes."

(Réaumur). In the Netherlands and Belgium it also extends inland along the rivers (Snellen). In the most southern parts of its range, *e.g.*, on the dunes to the west and south of Biskra, it is sometimes exceedingly abundant (Eaton), it also abounds on the almost bare slopes of the rocky island of Capri (White), also along the shores of the Bilbao river in Spain (Bell). On the dry sloping banks of the alpine valleys branching out of the Rhine valley, the valleys of Dauphiny, Savoy, the Tyrol, the Caucasus, and the eastern Himalayas it is sometimes very common. Mathew found the larvæ abundantly on the seashore below the celebrated Bulair Lines, also in woods near the coast of the Sea of Marmora. Walker notes that the species is quite common on the "neutral ground" at Gibraltar, and in all the cork woods of the district, whilst Mathew says it occurs also on the coast sandhills between Gibraltar and Algeçiras.

TIME OF APPEARANCE.—The emergence of the imagines appears to be very irregular. Normally the moths emerge from pupæ of the previous year in June and July in the more northern part of its range, and only occasionally in the autumn from pupæ of the year, so that sometimes from the same batch (the larvæ reared under identical conditions) one or two examples will emerge about three weeks after attaining the pupal stage, the remainder coming out the following year at irregular periods from June to August. In the southern part of its range the species appears to be continuously-brooded, imagines appearing in March-April, June, August and October-November, although irregularities in the various broods make it probable that one might obtain imagines (and larvæ) at any time between March and November in a state of nature, but, even in the warmest parts of its area, the two or three winter months—December to February—appear to be passed in the pupal state. Thus we have imagines in March, April and May at Malta, again in July, yet again in August, September and October, in April at Biskra, in April in the Sierra-de-Chiclana, in July at Albarracin, and possibly there is another emergence in many parts of Spain in September. The main emergences appear to be in June and September in the Bilbao river district (Bell), and in May and September at Gibraltar (Walker). The imagines also appear by the end of April in Turkestan, and in Asia Minor the species is everywhere common in May, and again from the end of July to the middle of August. Along the Mediterranean littoral it is reported as occurring from April to November, but, in the more northern lowlands, there appears to be a main emergence in May-June, and a partial second-brood in July-August, with a long pupal period through the winter. The species is recorded as appearing from May to the middle of November, everywhere very commonly, in Roumania (Caradja), and imagines are bred in August from July larvæ at Gallipoli (Mathew), from May until the end September at Eperies (Husz), whilst at Budapest the appearances are given as mid-April, mid-May, and again mid-June to August (*teste* Bartel); in Alsace from May to September (Peyerimhoff), and in the Haute-Garonne almost everywhere in May-June and August-September (Caradja). The following records also suggest double- or partial double-broods—June and September (rare) at Eutin, June and September in the Crefeld district, May and July at Halle (often in very great abundance), May-June and August-

September at Leipzig, in Thuringia, and in Silesia, where it is common, May-June and rarely in autumn at Baden, June and September at Wiesbaden, May-June and rarely in autumn in Switzerland, May and July at Fünfkirchen, July and September, in Tuscany (one suspects also a spring brood), July to September near Florence, June and August in the Loire-Inférieure. It is remarkable that few of the Italian dates are given earlier than June and July—at the end of May, and again in July and August about Rome—but our knowledge of the Italian lepidoptera is most unsatisfactory, and the species may be generally double- or even continuously-brooded in the warmer parts. In the mountains at a moderate elevation the imagines do not emerge until July-August—July 1st-15th in the Oetzthal (von Gumppenberg), August 15th-19th at Zermatt (Jones), July 28th, 1899, almost at summit of the Simplon Pass (Edwards)—here, too, the species is single-brooded as it is also in its more northern and western localities, the west coast of France, Belgium, Netherlands, the north coast of Germany and the Baltic districts. Other dates given are—middle of May at Teheran, May at Brussa, and the Kouldja district, May and June in the Ural district, end of May at Sarepta, end of July at Noworossiisk on the Black Sea, July and August at Aix-les-Bains, mid-September in Transsylvania, in July at Bergun, Simplon, Macugnaga, valleys of the Upper Inn, Bucovina, and most mountain districts. We also have June, common, at Brunswick, May-June at Augsburg and Frankfort-on-Main, July-August at Ulm, August at Bremen. Fritsch gives dates from May 10th-July 25th for Austro-Hungary, and only a few isolated autumnal ones. Réaumur notes it at the commencement of July on the banks of the Loire, whilst Harrison records it in June-July on the Brittany coast at Le Poldu, although three imagines emerged September, 1897, from August pupæ of the year. Occasionally mountain races gives an odd autumnal example in confinement, *e.g.*, imagines occur in the Val d'Herens in June-July, but Chapman reared one, from an Evolena larva, on September 23rd, 1899, after being only 18 days in the pupal stage. There are numberless records of these occasional autumnal emergences in confinement; thus Sich bred imagines from continental pupæ from July 8th-21st, 1901, and from an egg laid by one of these he obtained another imago on October 7th of the same year. Records like May 16th, 1901, at Malta (Fletcher), early August (from summer pupæ) at Malta (de la Garde), only help to prove the continuous-broodedness of the species here. Of actual dates of emergence or capture, besides those already noted, we have few. These are July 9th, 1860, at Alderney (Walker), May 5th-July 24th, 1890, from Newquay pupæ (St. John), June 21st, 1893, at light at Berne (Hiltbold), July 3rd-4th, 1898, at light, at Aigle, larvæ of all sizes occurring in the district at the same time (Lowe), August 15th-19th, 1898, at Zermatt (Jones), a large ♀ July 28th, 1899, almost at summit of the Simplon Pass on the Italian side (Edwards), July 24th, 1900, in the Statzer-Thal (Galvagni).

LOCALITIES.—The following list exhibits how a species, well-known as having no permanent residence in Britain, may appear to have a wide distribution in this country. AYR: Monkton ** (Dunlop). CHESHIRE: Bidston, near Birken-

** Probable immigrants or escapes.

head **, one (Morgan *teste* Gregson), Formby ***, between Little Brighton and Hightown, two larvæ *** (Gregson *teste* Ellis), Bolton **, one 1865 (Chappell). CORNWALL: near Newquay (Fry), Pendower Sands, Tresco † (Daws *in litt.*), Scilly Isles—nr. Tresco Abbey† (*teste* Bartel). DEVON: Braunton Burrows (extinct since 1832) (Raddon). DUBLIN: Killiney § (Hely *teste* Greene). GLOUCESTER: Cirencester ‡ (*teste* Jefferys). HANTS: Southampton ** (Weston), Isle of Wight ***, a single larva (Mitford). ISLE OF MAN†† (Dewhirst *teste* Hodgkinson). KENT: Deal** (Coverdale), Dover **, Dartford ** (Tutt). LANCS: Formby †† (Gregson). NORFOLK: King's Lynn ** (Barrett). SOMERSET: Taunton †† (Rawlinson), Bath ** (*teste* Donovan). SUFFOLK: near Ipswich *** (Bisshopp), Landguard Fort †† (Garrett), near Harwich ¶ (Durand). SURREY: Box Hill †† (Gardner). SUSSEX: Ecclesbourne ††, Hastings †† (Cosmo-Melvill *teste* Jenner). WARWICK: Coventry †† (Mercer *teste* Stephens). WORCESTER: Worcester †† (Smith, *Subs.*, p. 184). YORKS: Scarborough †† (Stainton's *Manual*)*.

DISTRIBUTION.—This species is exceedingly abundant from the Canaries throughout the whole Mediterranean littoral, from which it extends north to the shores of the Baltic, but to no great distance south, *i.e.*, into northern Africa. It extends throughout the Caspian and Aral district to the Himalayas and Kouldja, where it is abundant, whilst in the Achalzik district it is replaced by the pale form (or species) *centralasiae*. In the Alps of central Europe it is frequently abundant up to an elevation of 6000ft., above which altitude the larvæ are rarely found. AFRICA: Madeira, very common (Cockerell), Canary Isles—Teneriffe, abundaut (Longstaff), Algeria—Kouba (Lucas), Bona, common (Speyer), Biskra (Eaton). ASIA: Asia Minor, common—Cilician Taurus, &c. (Staudinger), both sides of the Sea of Marmora, commou (Mathew), Amasia, Tokat, Syria—Lebanon, Damascus (Lederer), steppes about Teheran (Bienert), northwest Asia Minor—Brussa, Olympus, Berglehnen, Maghnisa, Smyrna, Aidiu (Staudinger), northern Persia—near Schahkuh, Achal-Tekke district—Aschabad, Mangyschlak peninsula, Ural and Turgai provinces (*teste* Bartel), Pamirs, Kouldja district—Musart, Valley of Ili, (Alphéraky), Turkestan (Erschoff), Siberia (Speyer). AUSTRO-HUNGARY: Taufers valley, Innsbruck (Weiler), Tyrol, not rare—Oetzthal (von Gumppenberg), Upper Inn valleys, Trient, between Sarca aud Riva (Hinterwaldner), Bucovina, everywhere common—Solka, &c. (Hormuzaki), Pressburg (Rozsay), Bohemia, commou, Carlsbad (Nickerl). Galicia, very common, almost everywhere—Lemberg, Brody, Tarnów (Garbowski), only in certain seasons (Nowicki), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Brünn (Schneider), Hermannstadt (Czekelius), Eperies,

** Probable immigrants or escapes.

*** No doubt larvæ of *Celerio gallii*.

† Daws states that the iusect has been recorded from here. We cannot trace the record. Nor can we trace Bartel's authority for Tresco Abbey.

§ Birchall doubts this record, see *Ent. Mo. Mag.*, x., p. 153.

‡ A hearsay record. Almost certainly an error of determination.

†† Wants confirmation badly.

¶ Probable introductions for purposes of trade.

* The following records, to be considered in their detail, are chosen as examples that will give some idea of part of the evidence on which this species rests as British: (1) Three caterpillars taken near Coventry in 1827 (Mercer *teste* Stephens). (2) A fullfed larva at Formby on grass, August, 1850 (Gregson, *Zool.*, 2298). (3) At Taunton, a day or two before October 15th, 1857 (Rawlinson, *E. W. Int.*, 1857, p. 29) [The date is most unusual even for an immigrant imago in Britain]. (4) A single larva in the Isle of Wight in 1859 (Mitford) [The great *C. gallii* year]. (5) Two larvæ at Ipswich, September 17th, 1870, feeding on *Galium verum* (Bisshopp, *Ent*, v., p. 181) [Certainly those of *C. gallii*]. (6) Two imagines, one a remarkable aberration, exhibited by Higgins, September 17th, 1873, at the meeting of the Ent. Soc. of London, said to have been bred from near Harwich, where several larvæ were stated to have been takeu in June, 1872, by Durand (*Ent.*, viii., pp. 46, 263) [The possibility of larvæ occurring at Harwich in "June" is exceedingly remote. Nothing seems to have been known of Durand as au entomologist]. (7) Imago taken at Bowdon, 1886; wings crippled on right side (Chappell, *Ent.*, xix., p. 250) [Chappell found that he had been the victim of a fraud and destroyed the specimen, *vide*, *Ent.*, xx., p. 108]. (8) Three larvæ near Cirencester, August, 1900, by a lad (Jefferys, *Ent.*, xxxiv., p. 25) [A most unsatisfactory record. Evidently an error of determination]. Many of the other records are just as unsatisfactory.

common (Husz). Hungary — Kocsocz (Vángel), Gölnitz (Hudák), Cracow (Zebrawski), Trafoi (Wocke), Glockner (Mann), Upper Carinthia — Salzburg, &c. (Nickerl), Heiligenblut at 4000ft. (Staudinger), Lavantthal (Höfner), Upper Styria—St. Lambrecht (Kodermann), Lower Austria—Vienna, Moravia—on the Dubowitza, common, Mährisch-Trübau, Ungarisch-Brod, Hungary, everywhere common—Transsylvania, Kaschau, Leutschau, Rosenau, Neusohl, Raab, Budapest, Heveser Comitat, Debreczen, Grosswardein, Fünfkirchen, Josefsthal, Croatia, Fiume, Mehadia, nr. Orsova (*teste* Bartel), Upper Austria—Inn valleys, Pöstlingberg, Linz, &c. (Himsl), Statzer-Thal—Brenner district (Galvagni). BELGIUM: on banks of Meuse—Louvain, rare (Donckier), Nieuport (*teste* Bartel), near Namur, common, Virton, Lives, Ile de la Plante (Derenne), Arton, Ardann (Lambillion). BULGARIA: Varna (*teste* Bartel), Sofia district, common everywhere (Bachmetjew). CHANNEL ISLES: Guernsey—L'Ancresse Bay, formerly (Luft), Jersey—St. Ouen's Bay (Piquet), St. Helier (Batho), Alderney (Walker). CYPRUS (Mathew). DENMARK: Copenhagen, Kjöng (Bang-Haas), Sjäëlland (Boie). FRANCE: common everywhere (Berce), banks of Loire, between Blois and Langés (Réaumur), Fontainebleau (John), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne—Nohant, Sologne, St. Florent, Guéret (Sand), Eure-et-Loir, common (Guenée). Haute-Garonne, common to 5234ft. on Monte Cagire, Toulouse (Caradja), Puy-de-Dôme (Guillemot), Var (Cantener), Morbihan, common (Griffith), Gironde (Trimoulet), Aude, common near the sea (Mabille), Loire-Inférieure—Pornichet (Bonjour), Saone-et-Loire, common in all the chalk districts (Constant), Seine-Inférieure (Viret), St. Quentin (Dubus), Deux-Sèvres (Maillard), Sarthe (Desportes), Dauphiné Alps—La Grave, Bourg d'Oisans, locally common (Tutt), Maritimes-Alpes (Constant), Grenoble district, Pyrénées-Orientales, common—Vernet-les-Bains, dept. Doubs—Besançon, Paris district (Oberthür). Paris district—Bois de Boulogne, Vincennes, Vaisinet, le Calvaire; banks of the Marne—near Pont de Saint Maur (Godart), Touraine, La Vendée (Graslin), Meuse, Moselle and Meurthe districts (Speyer), La Manche, common—Cancale, Ille-et-Vilaine—St. Jacut, Côtes-du-Nord—Brest, Finisterre, never outside the maritime zone of these departments (Oberthür), Brittany—Le Poldu, abundant (Harrison), St. Pol de Léon, most abundant (Melhuish), St. Briac, near Dinard, abundant (Mathew), the Cevennes district, Montpellier, dept. Haute-Saône (*teste* Bartel), Aix-les-Bains, very common (Agassiz), valleys of the western Pyrenees, common — Biarritz, &c. (Jones). GERMANY: wherever foodplant grows (Heinemann), southwest Germany—Frankfort, Taunus, &c., common, becomes rare as far north as Giessen (Koch), northwest Germany, almost everywhere (Jordan), Rhine Palatinate (Bertram), Wurtemberg, very abundant (Seyffler), Giessen, once (Dickore), Lower Elbe district—Elbufer, Eimsbüttel (Zimmermann), Briesgau—Kaiserstuhl (Weismann), Waldeck district, southern parts only, restricted by growth of foodplant—Arolsen, &c. (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich, common some years (Kranz), Rudolstadt, common (Meurer), Mecklenburg (Schmidt), Bremen (Rehberg). Saxon Upper Lusatia, distributed but rather rare — near Kamenz (Schütze), Dresden district, everywhere common (Steinert). Thuringia, common—Gotha, &c. (Krieghoff), Prussia—Königsberg, Dantzig, rare, Frauenburg, Stargardt, rare (Grentzenberg), Rastenburg (Klups), Upper Lusatia, locally not rare—Lauban, Riesen-Gebirge, rare (Moeschler), Nassau, wherever foodplant grows (Rössler), Silesia, everywhere common (Assmann), Ratisbon (Schmid), Pomerania —Stettin, very rare, the Schwalbenbergen at Garz, common (Hering), Dessau, common (Richter), Alsace, common (Peyerimhoff), Wernigerode (Fischer), Brunswick, common (Heinemann). Hanover, sparingly (Glitz), Frankfort-on-Oder, common (Kretschmer), Eutin (Dahl), Irttau (Höge), Hartz Mts. (Speyer), Nassau—Biedenkopf, abundant (Jäger), Schwerin, Kendsburg, Hamburg, rare, Oldenburg, Crefeld district—Mündelheimer Damm, Düsseldorf, Duisburg, Barmen, Elberfeld, common, Ahrthal, Wetterau, Cassel, Magdeburg, Leipzig—Taucha, the Harth, near Dösen, Bienitz, in the Hohburger Schweiz, Kissingen, Würzburg, Passau, Ingolstadt, Augsburg, Ulm, Kempten, Darmstadt, common, Frankfort-on-Main, Mayence, Nassau—Wiesbaden, Oberhessen —Büdingen, Bavarian Palatinate (*teste* Bartel), Alsace—Strasburg (Peyerimhoff), Baden—Constance, Carlsruhe, Durlach, very common (Reutti), Chemnitz (Pabst), Heligoland (Gätke). Rhenish Prussia—Gerolstein (Jones), Berlin district, common (Pfützner), Hildesheim, very rare (Grote). GREECE: Parnassus, Attica (Staudinger), Crete, common—Canea, Suda Bay (Fletcher), Lemnos, Volo, Cyprus, Corfu, common Tinos, Syra (Mathew). ITALY: throughout (except in Sardinia and Corsica), rather common (Curò), Sicily, very common throughout—Nicolosi, Etna district, Mondello (Minà-Palumbo), Roman Campagna (Calberla), rare at Courmayeur, 5000ft. elevation (Tutt), Modena (Fiori), Capri, abundant (White), Lombardy, Liguria, Tuscany—near

Florence rare, Fondi, Otranto (*teste* Bartel). MALTA: abundant (Fletcher). NETHERLANDS: most provinces, especially along the rivers—Friesland, Zeeland, &c. (Snellen), Breda, not rare (Heylaerts), banks of the Scheldt (Mead). PORTUGAL (*teste* Bartel). ROUMANIA: very common throughout—Jeschëlnicza-az-Al-Duná, &c. (Caradja). RUSSIA: Baltic provinces (Siutenis), Moscow govt. (Albrecht), Crimea, south coast (Melioransky), Transcaucasia, common everywhere—near Borjom, Tiflis, Kodjori, Talisch (Romanoff), Lenkoran, common (Speyer), south Russia (Moeschler), Caucasus (Speyer), govts. Pskow, Mogilew, Kiev, Poland—Kamenez-Podolskii, Wolhnia, Bessarabia, govt. Cherson, Aluchta, govt. Jekaterinoslaw, Poltawa—Lubny, Charkow, Orel, Kaluga, Tambov, Noworossiisk on Black Sea, govt. Tawritschesk, Stavropol, north Caucasus, shores of Caspian Sea (*teste* Bartel), Lower Volga district, Kasan district, Simbirsk, Ufa, Ural dist., Orenburg, govt. Samara, Saratov, Astrachan—Sarepta, the Achtuba (Eversmann). SCANDINAVIA: Lund, one only (Wallengren), Sweden—Scania (Linné). SPAIN: Andalusia—Malaga, abundant, particularly near the sea (Rambur), Ronda (Speyer), Teruel—Martin del Río, Segorbe (Zapater), Barcelona, common (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao river district, common (Bell), Sierra-de-Chiclana (Bartel), Albarracin district (Chapman), Gibraltar (Walker), coast between Gibraltar and Algeçiras (Mathew). SWITZERLAND: throughout the plains, sometimes common, at other times rare, extends into the mountain regions to 6000ft. (Frey), in the warmer parts very common (Brown), Val d'Herens, abundant—Villa, Evolena, between Haudères and Arolla, &c., Simplon (Tutt), between Grindelwald and Zweilütschinen to, 2500ft., abundant (Speyer), Lausanne, abundant (Chaumette), Grisons—Vals Platz extremely abundant (Merrifield), Macugnaga (Edwards), Engadine—Davos-Platz (Sellon), Aigle (Lowe), on the mountains of the Upper Engadine to 6000ft., between Sils-Maria and the Maloja, Wirthshäuern (Frey), near Basle (Riggenbach), Bremgarten (Boll), Lenzburg, the Juras of the Cantons Aargau, Solothurn, and Basle (Wullschlegel), Aarberg, formerly common, Schupfen, rare (Rothenbach), Neuenstadt (Couleru), Gadmenthal to 5300ft. (Rätzer), Berne, near Bex, and the warmer parts of Valais, common (Meisner), Vevey (Wullschlegel), Geneva, (Mus. coll.), near Zurich (Frey), Zurich (Nägeli), Mettmenstätten, Nürensdorf (Dietrich), Winterthur district, in most years common (Biedermann), in the lowlands of the Canton Glarus (Heer), Canton St. Gallen to the mountain region, not rare (Täschler), Tarasp (Killias), Belp-Berg, near Signal, common, Zug, Erhebungen from 500ft.-6000ft., near Bergün (*teste* Bartel), Bechburg (Riggenbach-Stehlin). TURKEY: Eastern Roumelia—Slivna (*teste* Bartel), shores of Sea of Marmora, Gallipoli, common (Mathew).

Subfam.: DAPHNIDINÆ.

We have already suggested (*antea*, p. 140) that the Eumorphids in their wider relationships appear to fall into two sections, *Philampelina* and *Eumorphina*. It is quite evident that, unless we retain these names, these divisions are really of subfamily value, and, if we may extend the groupings suggested (*antea*, vol. iii., pp. 365-367), it is clear that the *Eumorphidae*, in the widest sense, may include the *Sesiinae*, *Philampelinae*, *Eumorphinae*, and possibly other groups, of which we, at present, are much too ignorant to formulate even a guess. At any rate, for the purposes of this work, we have now to consider the *Philampelina* section, which would include the Darapsids, Nephelids, Philampelids, Pachyliids, Acosmerygids, Daphnids, &c.

The Nephelids are apparently Eumorphid, but exhibit many very Sesiid characters, whilst the Darapsids are possibly more generalised than the Sesiids and Nephelids, and were given off from the main Eumorphid stem below either of these groups. The Darapsid genera, *Darapsa* and *Gurelca*, have unspecialised pupæ, and yet are distinctly Eumorphine, so that the suggestion at once arises that the primitive Eumorphid had not only primitive larvæ (*antea*, vol. iii., p. 365), but may, without violence, be assumed to have had primitive pupæ, so that the Eumorphids may be

looked upon as the main Sphingid stem, with Hemarids, Sesiids, and even the Sphingids and Amorphids as branches, that is, giving the Sphingids a monophyletic instead of diphyletic grouping, although our further work shows that Bacot's suggested grouping *(anteà*, vol. iii., pp. 365-366) has much in its support, and, unless one is prepared to grant a diphyletic origin to the oblique-striped larvæ—Amorphids, Sphingids—a mode of grouping based largely on that suggested by Bacot must be granted, and, as certain genera—*Ceratomia*, *Daremma*—possibly to be referred to the *Sphingidae (sens. strict.)*, have unspecialised pupæ, and of a character not far different from that of the more generalised Eumorphids—*Darapsa*, *Gurelca*, &c.—possibly such an arrangement is not so difficult as at first appears.

Although it may be considered as outside the scope of our work, it may be well to consider the position of the Daphnids with regard to the rest of the Eumorphids *(sens. lat.)*. For this purpose Chapman and Kaye give the following grouping, starting with a basal Eumorphid not very definitely separable from the Sesiids:

1. *Darapsinae* *—Larva with subdorsal lines without tendency to break up into ocellated spots. Pupa with labrum ventral. Puparium superficial. Imago with nervure 8 of hindwing sharply curved upwards at starting, approximating at end of cell and receding well beyond cell.
2. *Philampelinae*—Larva with subdorsal line simple, but with tendency to reversed oblique stripes and to breaking up of spiracular line. Pupa with labrum anterior. Puparium subterranean. Imago with nervure 8 of hindwing only slightly upcurved at starting, approaching 7 before the end of the cell and continuing almost parallel for a long way beyond; antenna with a long produced tip.
3. *Daphnidinae*—Larva with eye-spot on thorax. Pupa with labrum dorsal. Puparium superficial. Imago with nervure 8 of hindwing only slightly upcurved at starting, approaching 7 before the end of the cell and continuing almost parallel for a long way beyond; antenna with a very short strongly recurved tip.
4. *Eumorphinae*—Larva with abdominal eye- or ring-spots. Pupa with labrum anterior or dorsal. Puparium superficial. Imago with markings dominated by streaks from apex; nervure 8 of hindwing approximating to 7 well beyond cell, and receding again after a very short distance.
    - *a. Phryxidi*—Larva with thoracic and abdominal ring-spots. Pupa with labrum anterior. Imago with large head, &c.
    - *b. Eumorphidi*—Larva with abdominal eye-spots and retractile thorax. Pupa with various specialisations. Imago more primitive, small head, &c.

Groups such as the Acosmerygids, Pachyliids, &c., are not considered here, since they are outside the proposed range of our work.

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* We are fully aware that the terminology of these is not in accordance with our previous work in this group, in which we have treated the whole of the Eumorphids as a subfamily of the *Sphingidae*. As our work has progressed, however, our ideas have become much modified, and we are inclined to look upon the *Eumorphidae* as a subfamily of quite equal importance with the *Sphingidae*. Besides, to have maintained these as tribes, it would have been necessary, owing to our limited terminology, to make *Darapsidi*, *Philampelidi*, *Daphnididi* equal, phylogenetically, to *Eumorphidi*, *Phryxidi*, &c., a view that would have been entirely wrong, for a branch systematically is of importance, not in proportion to its number of species, nor to the number of subbranches into which it divides, but to the amount of its differences from the remaining branches. Therefore, if we retain *Phryxidi*, *Hippotionidi*, *Eumorphidi* and *Elibiidi* as tribes of *Eumorphinae*, we must make the other great Eumorphid branches subfamilies equal in value to *Eumorphinae (sens. rest.)*—*i.e.*, *Darapsinae*, *Philampelinae*, &c.,—to show their phylogenetic value.

The Daphnids proper, as we show later *(infrà)*, incline more to the Philampelid than to the Eumorphid *(sens. strict.)* branch. They are quite outside the latter on adult larval characters, and, with the Acosmerygids and possibly other tribes, form a short branch arising close to where the main Philampelid and Eumorphid branches *(anteà*, p. 140) separated.

Tribe : DAPHNIDIDI.

The Daphnid tribe belongs rather to the Philampelid Eumorphids than to the Eumorphids *(sens. strict.)*, and is, possibly, somewhat closely allied to the Acosmerygids. Its larva is so far Philampelid that it has (1) the subdorsal line well-developed, and (2) no abdominal ring- or eye-spots. The imago has also the Philampelid and not the Eumorphid type of marking, which is dominated by the streak from the apex. On the other hand, the Daphnid larva has developed a highly-specialised eye-spot on the metathorax, whilst the Daphnids further disagree with the Philampelids in that the pupa is of that form which we have educated ourselves to look upon as a surface one (in this respect agreeing with the Acosmerygids), whilst that of the latter is subterranean. The pupal characters appear to be close to those of the Hippotionids. On the whole, however, the Daphnids are nearer the Philampelids than the Eumorphids *(sens. strict.)*. Kirby notes *(Handbook*, iv., pp. 38-39) that, in the Philampelids, "the imagines are mostly green or brown, with the costal half of the hindwings lighter green. . . . All the species of *Philampelus* and its allies are American, except *Euchloron*, Bdv., which includes one or two species with bright green forewings and black and yellow hindwings, which inhabit Africa and Madagascar." He further considers that the genus *Daphnis* represents *Philampelus* in the Old World, but notes that "the antennæ are less hooked, the wings narrower and more pointed, and the hind tibiæ armed with five very long spurs." It is, however, in the larval stage that great differences appear, although even the broader larval and pupal characters suggest in some measure, a distinct alliance. The peculiarity of the larvæ of the Nearctic Philampelids is that they have a long caudal horn in the 1st instar, but this is lost before they become adult, *e.g.*, the larva of *Philampelus vitis* is green and has a long, slender, recurved, reddish horn when it hatches, becoming, however, reddish-brown without a caudal horn when adult, whilst the young larva of *P. pandorus* has a very long, straight, pink caudal horn, which curls up and shortens, and is altogether lost at the third moult, whilst the newly-hatched larva of *Pholus achemon*, with a slender recurved reddish caudal horn half as long as its body, loses it altogether before reaching maturity, its place being represented only by a polished tubercle with a central black dot. Most of these larvæ have a dark mediodorsal line, a pale subdorsal line, whilst the abdominal segments 2—8 have a series of pale blotches containing the spiracles, the blotches being really modified oblique lines, with a front to back slope from the anterior edge of the segment, just below the subdorsal line.

With regard to the Daphnid imago, Kaye gives *(in litt.)* the following characters :

Wings fairly broad (broader than is usual in Eumorphids). Body heavy, bluntly pointed; legs stout and strong (much more so than in Eumorphids). On the underside of hindwings a clear, white, discoidal spot in all the green species, the brown species—*bhaga*, *protrudens* and *torenia*—showing a gradual reduction of this mark from *bhaga*, through *protrudens* to *torenia*, in which last no trace of it can be detected. A very decided colour-character is shown in the ♂s of all species, *viz.*, a dark dorsal blotch on the anal segment, and a pair of dark subdorsal blotches on the antepenultimate segment; in the ♀ a pair of dark subdorsal blotches on the anal segment only. The anal segment is much larger in the ♀ than in the ♂. The head and eyes very large and prominent, no stripes on abdomen, but only different shades of colour, with the segmental fringes generally well-defined and pale-coloured. Spurs on hind tibiæ exceedingly strong.

It may be observed that the absence of markings on the abdomen gives the Daphnids a very distinct facies. One species *(bhaga)* has a large fan-shaped tuft to the anal segment in the ♂. Two species *(protrudens* and *torenia)* have neither the characteristic white discoidal spot, nor anal tuft, and are brown in colour, but the markings are in all extremely alike. The tribe is most developed in the Indian Region, particularly in southern India and Ceylon.

Chapman gives the following diagnostic summary of the tribe:

IMAGO.—Wing markings consist almost entirely of what, in most other groups, are shadings to the obliteration of all the ordinary lines. PUPA.—Pale-coloured for surface pupation, wings smooth, last segments truncate rather than tapered, anal spine very small. LARVA.—Twin eye-spots on mesothorax, subdorsal line complete on abdominal segments.

Kaye has made a somewhat exhaustive examination of the Daphnids available, and suggests the following generic divisions:

(1) Head not projecting; abdomen long, not tufted; nervures 6, 7 from upper angle of cell, rarely stalked; legs very long; spurs to hind tibia exceptionally long and strong, spines on front tibia weak—*Daphnis nerii* (type), *hypothous*, *andamanus*, *minimus*, *ernestinus*, *layardi*, *horsfeldii*, *protrudens*.

(2) Head not projecting; abdomen long, not tufted; nervures 6, 7 stalked; legs of medium length; spurs to hind tibia of moderate length, not particularly strong; spines on front tibia strong—*Regia*, n.g., *torenia* (type of genus).

(3) Head very projecting; abdomen stumpy with a large fan-shaped tuft at apex; nervures 6, 7 of hindwing from upper angle of cell; legs short, spurs to hind tibia short—*Indiana*, n.g., *bhaga* (type of genus).

The structure of *Indiana bhaga* comes very close to certain Pachyliids, *e.g.*, *Pachylia inornata (syces)*, and these in turn show a close relationship with the Philampelids (Kaye).

Genus: DAPHNIS, Hübner.

SYNONYMY.—Genus: *Daphnis*, Hb., "Verz.," p. 134 *(circ.* 1822); Stphs., "Illus. Haust.," iv., app. p. 5 (1835); "List Br. An. Br. Mus.," p. 29 (1850); Curt., "Brit. Ent.," xiv., fol. 626 (1837); Wood, "Ind. Ent.," p. 239, pl. lii., fig. 37 (1839); Westd., "Gen. Syn.," p. 89 (1840); Walk., "List, &c.," viii., p. 188 (1856); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 572 (1876); Moore, "Lep. Ceyl.," ii., p. 14, pl. lxxxii., figs. 1—1*a* (1882); Saalm., "Lep. Madag.," i., p. 123 (1884); Kirby, "Cat.," p. 672 (1892); "Handbook," &c., iv., p. 39 (1897); Garbowski, "S.B. Akad. Wien," ci., p. 921 (1892); "Hampsn., "Ind. Moths," i., p. 94, fig. 54 (1892); Staud., "Cat.," 3rd ed., p. 100 (1901). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 490 (1758); xiith ed., p. 798 (1767); Hfn., "Berl. Mag.," ii., p. 176 (1766); Fab., "Sys. Ent.," p. 538 (1775); "Spec. Ins.," ii., p. 142 (1781); "Mant.," ii., p. 93 (1787); "Ill. Mag.," vi., p. 287 (1807); Schiff., "Schmett. Wien.," p. 42 (1775); Ill's. n. Ausg., p. 16 (1801); Cram., "Pap. Exot.," iii., pl. 224, D (1779); Esp., "Schmett. Eur.," ii., p. 43, pl. iv., figs. 1-3; p. 199, pl. xxvii., figs. 1-2 (1779); Bergs., "Sphing. Larv.," p. 9 (1782); Bork., "Sys. Besch.," ii., pp. 74, 138, 173 (1789); Brahm, "Ins.-Kal.," ii., p. 524 (1791); Hb., "Eur. Schmett.," fig. 63 (1796); text, p. 95 *(circ.* 1805); "Larv. Lep.," ii., Sph. iii., Legit. B *a*, figs 1*a*—*b* *(circ.* 1800); Shaw and Nodder, "Viv. Nat.," x., pl.

372 (1799); Schrk., "Faun. Boica," ii., 1, p. 229 (1801); Ochs., "Die Schmett.," ii., p. 201 (1808); Godt., "Hist. Nat.," iii., p. 12, pl. xiii (1822); Bdv., "Eur. Lep. Ind. Meth.," p. 32 (1829); Meig., "Eur. Schmett.," ii., p. 132 (1830); H.-Sch., "Sys. Bearb.," ii. p. 85 (1846); Speyer, "Geog. Verb.," i., p. 317 (1858); li., p. 280 (1862); Hein., "Schmett. Deutsch.," i., p. 144 (1859). *Deilephila* [Lasp.,] "Jena. Allg. Lit. Zeit.," iv., p. 100 (1809); Ochs., "Die Schmett.," iv., pp. 42-43 (1816); Stphs., "Ent. Mag.," i., p. 525 (1833); Bdv., "Icon. Chen.," pl. 3. fig. 1 *(circ.* 1840); "Gen. et Ind. Meth.," p. 47 (1840); Dup., "Icon. Chen.," pl. ii., fig. 1 *(circ.* 1835); "Cat. Méth.," p. 42 (1844); Assm., "Schmett. Schles.," ii., p. 31, pl. x., figs. 33*a*—*d* (1845); Heydr., "Lep. Eur. Cat. Meth.," ed. 3, p. 19 (1851); Staud., "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 37 (1871); Snell., "De Vlind., p. 93 (1867); Berce, "Faun. Franç.," ii., p. 25 (1868); Nolck., "Fn. Lep. Estl.," i. p. 89 (1868); Mill., "Cat. Lép. Alp.-Mar.," p. 117 (1872); "Nat. Sic.," vi., p. 3, pl. i., fig. 7 (1886); Cuní y Mart., "Cat. Lep. Barc.," p. 40 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 112 (1875); Frey, "Lep. Schw.," p. 58 (1880); Auriv., "Nord.-Fjär.," p. 46 (1889); Minà-Pal., "Nat. Sic.," vii., p. 184 (1892); Meyr., "Handbk.," p. 296 (1895); Klooss, "Ill. Woch. für Ent.," i., p. 483 (1896); Unterberger, "Ill. Zeits. für Ent.," iii., p. 138 (1898); Bartel, "Pal. Gross-Schmett.," ii., p. 52 (1901). *Elpenor*, Oken, "Lehrb. Zool.," i., p. 760 (1815). *Eumorpha*, Hb., "Franck Cat.," p. 87 (1825). *Choerocampa*, Dup., "Hist. Nat.," supp. ii., pp. 159-160 (1835); Humph. & Westd., "Brit. Moths," i., p. 21 (1841); Dbldy., "List Brit. Lep.," p. 3 (1847); Sta., "Man.," i., p. 95 (1857); Humph., "Gen. Brit. Moths," p. 11, pl. iii., figs. 1-2 (1860); Wallgrn., "Skand. Het.," i., p. 48 (1863); Newm., "Brit. Moths," p. 10 (1869); Bdv., "Spec. Gén. Lép. Hét.," i., p. 224 (1875); Kirby, "Eur. Butts. and Moths," p. 72, pl. xviii., figs. 3*a*—*c* (1879); (Tutt), "Brit. Moths," p. 33 (1895); Barr., "Lep. Brit.," ii., p. 62, pl. liii (1895); Lucas, "Brit. Hawk-Moths," p. 117 (1895); South, "Ent.," xxxi., p. 156 (1898). *Metopsilus*, Dunc., "Brit. Moths," p. 156 (1836). *Chaerocampa*, Ramb., "Cat. Lép. And.," p. 132 (1866).

The genus *Daphnis* is characterised *(Verzeichniss*, p. 134) by Hübner as follows:

Forewings a particularly beautiful green, with softly variegated markings—*Daphnis megeacus*, Hb. *(eacus*, Cram.), *D. hippothous*, Cram., *D. nerii*, Linn.

In 1835, Stephens, in the appendix to vol. iv of his *Illustrations*, p. 5, places *nerii* in *Daphnis;* in 1837, Curtis figured *nerii (Brit. Ent.*, xiv., fol. 626), and declared it to be the type of Hübner's genus, and diagnosed it as follows:

Antennae inserted towards the base of the head and close to the eyes slightly attenuated at the base and apex, which latter is hooked, being terminated by a slender setaceous joint somewhat pectinated with scales, rather stout in the male, and transversely striated and fringed with hairs (fig. 1, ♂, portions of the underside and apex); slender and simply clothed with scales externally in the ♀. *Maxillae* not more than half the length of the animal, but very spiral (fig. 3). *Labial palpi* curved upwards, pressed close to the head and a little keeled (fig. 4), densely clothed with scales, rather long, slender, and triarticulate, basal joint curved and clavate, 2nd as long, more elliptical, 3rd very small and nearly globose (fig. 4*a)*. *Head* trigonate; eyes very large, hemispherical, and prominent; ocelli, none. *Thorax* not broader than the abdomen, which is conical. *Wings* deflexed in repose; superior lanceolate, the posterior angle obtuse; inferior small, ovate, the apex a little pointed, the anal angle slightly lobed. *Legs* very strong, thighs short, tibiæ densely clothed with scales, anterior with a large internal spine, intermediate with two strong unequal spurs, horny and acute at the apex, in the hinder there is a pair also a little above the apex, one spur in each being very long (fig. 8); tarsi 5-jointed, spinal beneath, hinder pair longer than the antennæ, basal joint exceedingly long, claws and pulvilli small. *Larvae* with 6 pectoral, 8 abdominal, and 2 anal feet, the tail short and incurved—*Daphnis nerii* (type of the genus).

Curtis further notes *(loc. cit.)* that "*Daphnis nerii* is closely allied to the true Sphinges, and whether it be right to make a genus of it may be questionable; there are, however, several exotic species that will group well with it; the caterpillar has a different character

from *Sphinx* (pl. 195) the spiral maxillæ are very much shorter, and the inferior wings are somewhat lobed, as in *Deilephila*." In 1840, Westwood followed Curtis in selecting (*Generic Synopsis*, p. 89) *nerii* as the type of *Daphnis* and diagnosed it as:

Wings entire, acute, posterior slightly lobed; spiral tongue long; antennæ and labial palpi slender: caterpillar with the neck retractile—*nerii*, L.

All our better informed authorities, Hübner, Stephens, Curtis, Westwood, Moore, &c., appear to have been agreed on the very isolated position of *Daphnis nerii* among the Palæarctic Eumorphids, and even Staudinger in the 3rd ed. of his *Catalog*, p. 100, isolates it from them. It is certainly far removed from the Hippotionids and Eumorphids (*sens. strict.*) with the species of which it has been united, even in the same genus, by such authors as Stainton, Meyrick, Barrett, &c. So clearly marked is this distinction, that one feels no hesitation in removing it from the Chœrocampid, and placing it on the Philampelid, side of the Eumorphid phylum, but two great difficulties occur in dealing with the genus (as also with the tribe in which we place it): (1) Our entire ignorance of the larval ontogeny of typical species of *Daphnis*. (2) Our ignorance of the life-histories of the species supposed, on superficial imaginal characters, to be related to *Daphnis nerii*. Of the detailed structure of the egg we know nothing. The pictures of the adult larva show a very characteristic difference from the larvæ of any of the groups described by Weismann (*antea*, pp. 141-142), for the single pair of well-developed twin ocellated spots is placed on the side of the metathorax although developed from the subdorsal line, as is the case in the Eumorphids already considered, the rest of the subdorsal (on the abdominal segments) running as an unbroken line to the caudal horn. Thus, it exhibits three peculiarities: (1 and 2) Peculiarities in the position and character of the ocellated spot, and (3) A peculiarity in the maintenance of the subdorsal line, neither point being touched on by Weismann. The pupa is characteristically Eumorphid, of the specialised type seen also in *Hippotion celerio* and *Panacra vigil*, whilst the imago, in its markings, is quite *sui generis*, and very unlike those best known to us and exemplified by the species of the genera *Eumorpha*, *Theretra*, *Hippotion*, *Phryxus*, *Hyles* and *Celerio*. In this respect it approaches much more closely to the Acosmerygids and Philampelids with which we trace a close alliance. Whether the larval and pupal characteristics of *Daphnis nerii* are common to other species that must be referred to the Daphnid line of development we do not know, except that the larva of *D. Hypothous* is figured as being very similar to that of *D. nerii*, nor have we been able to obtain from the voluminous writings on the Sphingids any details that help us in our work. Whether, therefore, the characters noted are generic or tribal we cannot even hazard a guess, although we surmise that they will prove to be the latter, *i.e.*, we shall expect the adult Daphnid larvæ to have metathoracic twin ocellated spots, and the pupæ to be highly specialised with frontal or dorsal labrum. Chapman writes (*in litt.*): The question as to whether *Daphnis* belongs to the *Eumorphina*- or the *Philampelina*-branch of the Eumorphids (*antea*, p. 140) is apparently rather one of words and sentiments (the personal equation) than of facts. The larva is characterised

by having the subdorsal line well developed, without trace of ever having been interfered with by modification into eye-spots, but eye-spots are well-developed on the metathoracic segment. This then would be a Philampelid larva with these eye-spots added. Since there is the tendency to break up the subdorsal line into eye-spots in all Sphingids we probably have one result of the tendency here, probably acting also in association with the origin of the Eumorphids. *Daphnis* would, in fact, seem to be a branch from the Eumorphid stem almost before it was definitely separated from the Philampelid, and whilst it was still possible to retain the greater part of the subdorsal line unchanged. This does not seem to have been possible in any Eumorphid in any stage in which the eye-spots were fully developed, whether on all or only on two segments, at any rate not in any whole group, though one or two species have a somewhat contrary aspect. Imaginally, *Daphnis* is of a totally different wing-pattern from any Eumorphid, but the pupa has a very great resemblance to that of *Hippotion celerio*. At first glance they are almost identical, and they resemble one another in a good many points of detail. They do, however, differ in several items, so that it is necessary to conclude that the resemblances are due to convergence. *Daphnis* pupa, however, with its light colour and weak texture resembles those of Eumorphids in being obviously adapted to surface pupation, whilst the pupa of the true Philampelid has a dark colour, and solid texture for subterranean pupation.

Daphnis nerii, Linné.

Synonymy.—Species: *Nerii*, Linn., "Sys. Nat.," xth ed., p. 490 (1758); xiith ed., p. 798 (1767); Hfn., "Berl. Mag.," ii., p. 176 (1766), &c. [Note.—This species has always been known by the Linnean name *nerii*. All references made under the generic synonymy of *Daphnis* (*anteà*, pp. 246-247) are referable here.]

Original description.—*Sphinx nerii* alis subangulatis viridibus: fasciis variis pallidioribus saturatioribus flavescentibusque. Roes., *Ins.*, i, phal. 1, t. 16. Frisch, *Ins.*, 7, t. 3. Habitat in Nerio (Linné, *Sys. Nat.*, xth ed., p. 490).

Imago.—90mm.—110mm. Head and thorax deep olive-green, marked with pinkish-grey (or dull yellow tinged with pink); the abdomen green, marked with faint pinkish-grey oblique lines on either side of each segment dorso-laterally, segmental incisions in upper part of abdomen whitish, a dark patch on either side of anus. Anterior wings dark green, marked with white (or yellowish), suffused with pink; the pale areas consist of a basal circle, treble oblique or angulated line towards base, an oblique median line curving at costa and continued towards anal angle, but stopping short about half-way across wing, a curved line parallel to last almost enclosing apical area and an oblique apical streak; the anal area fawn-grey, edged with pinkish-white, nervures whitish on outer half; fringes green. Posterior wings fawn-colour (or pinkish-grey) at base, a white waved line just outside middle, edged with darker, outer area dark green, anal area whitish; fringes white.

Sexual dimorphism.—The ♀ is larger than the ♂, though the variations in size are so great as in many cases to mask this. The ♂ has a more conical tapering abdomen, though in cabinet specimens the ♀, when devoid of eggs, presents a very similar outline. There

seems to be no difference in colour, marking, or form of wing. The ♂ antenna is the longer, as about 17mm. to 14mm., and is also thicker, as 0·8mm to 0·5mm. The joints are about equal in number (76), and the scaling is similar to that of other Eumorphids, *viz.*, one row of very short and two of longer (one a little longer than the other) scales to each segment. The first tibia is longer in the ♂, as 6·0mm to about 5·5mm.; the ♂ spur is about 3mm. in length, with the comb extending for about two-thirds of this length, the spur is proportionally very broad (1·3mm.); the spur on the ♀ first tibia is a little shorter (2·5mm.), and the comb extends along about half its length. The fan which the ♂ carries on the 1st abdominal segment (really the 2nd) arises just behind the spiracle, about the middle of the margin of the dorsal plate, and there passes to it a narrow process from the anterior margin of the ventral plate; this has, no doubt, something to do with the process of erecting and expanding it. It is really a small (for the size of the moth) wisp of hairs about 3·5mm. long. The following spiracles are not in the dorsal plate, but really in the lateral membrane. The marginal batons are obviously modified scales, being distinctly striated, though having the fusiform pointed form they have in other species (Chapman).

Gynandromorphism.—The following are the only gynandromorphs that we have been able to trace :—

α. Imperfect gynandromorph. Wings on both sides equally long; the forewings 47mm. long, left 26mm., right 25mm. broad; a decided difference in the hiudwings. Markings and coloration of the wings somewhat different. Left ♂ antenna not quite fully formed, right ♀ normal. Left frenulum perfectly ♀, the right one, half ♂ and half ♀; the little hook on the forewing for fastening the bristle is wantiug. Abdomen less pointed than in normal specimens; segmentation ♂, beiug 7-ringed, the last two segments divided by a complete iucisiou, and coloured and marked as in the ♂. On the left side a developed ♂ anal clasp is present, but moved so out of place that it lies obliquely over on the right; the corresponding clasp on the right side is rudimentary (*cf.* Speyer, *Stett. ent. Ztg.*, 1868, p. 238).

β. Left ♂, right ♀. As regards sex a perfectly halved hermaphrodite. Right forewing 48½mm. long, at the hind margin 26½mm. broad, left 46mm. and 24mm. respectively. Coloration of the ♀ wings somewhat deeper. Right antenna ♀, left ♂; frenulum and form of the segments likewise. Of the outer sexual organs only the large, somewhat projecting, left anal clasp is distinct; on the ♀ side the clasp is wanting. Bred by Grentzenberg of Dantzig (*cf.* Speyer, *Stett. ent. Ztg.*, 1869, p. 237).

γ. A gynandromorphous example in Dr. Staudinger's collection [Staudinger, *in. litt.* (Schultz, *Ill. Woch. f. Ent.*, ii., p. 393).

Variation.—The species exhibits a certain amount of size variation [British examples are often of good size, *e.g.*, 4ins. 4lin. at Hastings (Kent), 4¾ins. at Chickerell (Richardson)], and sometimes marked colour aberrations occur. Bartel notes (*Pal. Gross-Schmett.*, ii., p. 135) that examples from the neighbourhood of Constantinople are distinguished by their large size and fineness, as also are such as have fed chiefly on flowers of oleander; he says that Mützell, of Berlin, bred really wonderfully magnificent specimens by supplying the larvæ with this kind of food and raising the temperature as much as possible. In rare aberrations the green of the upperside becomes yellowish-brown. Unterberger, of Königsberg, records (*Ill. Zeits. für Ent.*, iii., p. 232) a colour aberration of a ♂ which had the beautiful olive-green of normal examples replaced by olive-brown, becoming ochre-yellow on the underside of the hindwings. The specimens from the Hawaiian Islands are stated by Butler (*E.M.M.*, xiv., p. 47) to differ in no

respect from the typical form. Lederer, however, notes that the Beyrout examples are smaller and duller coloured than those from Dalmatia; Oberthür observes that the Madagascar examples sometimes vary in colour, the ground-colour of the wings becoming olive-brown instead of green. Kirby observes (*Handbook*, &c., iv., p. 40) that "the insect varies chiefly in the lighter or darker shade of the ground colour, and in the amount of reddish or yellowish colour in the band on the forewings." The only described race appears to be the following:

a. var. *infernelutea*, Saalm., "Lep. Madag.," i., p. 123 (1884); Kirby, "Cat.," p. 672 (1892).—The specimens of var. *infernelutea*, m., before me, from Nossi-Be', are smaller than European specimens bred from larvæ. Mabille also notes the difference in size as a characteristic of Madagascar specimens; but no author has recorded any other difference. The coloration of the upperside is paler (blasser), the green tends more towards grass-green, and the paler hindwings have a dingy, ochre-yellow colour above the anal angle before the border, where the green tint is brightest in European specimens, and this colour extends suffusedly towards the apex of the wing. On the underside, the form and position of the markings differ little from those of the upperside, but they exhibit considerable difference in colour, as there is not a trace of green. All the shades which this hue forms in European specimens are here graded from golden orange-yellow to grey-brown. The former colour is brightest before the apex and hinder angle and between nervures 5 and 7, before the marginal area, on the forewings, and on the hindwings in the discoidal cell and before the anal angle; the white in the markings is slightly varied with rosy. The palpi and abdomen are grey-yellow, and the thorax and antennæ grey-brown. Among the very large uumber of European specimens which have been compared there was not one which showed even a trace of any tendency to pass into the orange-yellow of the undersurface.

Ovum.—Light green, small (compared with the size of the imago), and agrees somewhat in size, form, and colour with the egg of *Sphinx ligustri* (Bartel).

Egglaying.—The egg is attached to a leaf of *Nerium*, on the underside, adhering to the midrib (Millière). In central and northern Europe the immigrant females deposit their eggs on the leaves of the oleander-bushes grown in tubs, &c., usually several eggs are laid on one plant (Bartel). Winter notes a ♀ captured at Aldeby, Beccles, October 26th, 1857, which laid a number of eggs (*Ent. Wk. Int.*, 1857, p. 42).

Habits of larva.—In the Riviera the larvæ of the first brood of imagines (immigrants) live throughout July, and are fullfed from July 15th-30th, whilst the pupal stage lasts only some 16-18 days. The larvæ of the second brood are fullfed about the end of September, and the imagines emerge some three weeks later (Millière). In more northern countries both broods are usually somewhat later, dependent on the season. Godart notes, in 1822, that the insect occurs occasionally in Paris, but is common at Genoa, Turin and Nice, whilst, in 1819, the larvæ were abundant in the dept. Marne-et-Loire. Dormoy writes (*Ann. Soc. Ent. France*, 1836, pp. 363 *et seq.*) that, in 1835, the larvæ occurred in abundance in parts of France where they had never been noticed before, that M. Blanc reported taking 6 larvæ at Pont St. Esprit in June, 1835, on common oleander, that M. Paris took some 60 larvæ in August, 1835, at Epernay, on cultivated double oleander, the larvæ of various sizes, but that all, except a dozen, became feeble and died just before pupation, no doubt owing to a spell of dull wet weather, that M. Paris further reported finding, in ? 1833, the eggs of *D. nerii* on a

branch of oleander, and some 52 larvæ at Montpellier, in 1835, where he had also taken 5 or 6 larvæ in August, 1834, which produced imagines at the end of September. Dormoy expresses the opinion that the 1835 larvæ resulted from immigrants of 1834, a very improbable suggestion. Nowicki, of Thorn, in West Prussia, records (*Preuss. Provinz.-Blatt.*, xiv., pp. 309-311 ; xv., pp. 511-514) the capture of a larva, already past its 4th moult, on August 7th, 1835, as well as two smaller ones, several others having been killed, as well as moths, rather earlier in the year. He observes that the larvæ only liked the younger oleander leaves, but took readily to *Vinca minor*. Siebold (*loc. cit.*, xv., pp. 103-105) also records larvæ and the successful breeding of imagines therefrom at Dantzig, and adds that, in 1828, he bred it at Berlin, that, in 1837, they were reported at Chartres (Lesage), and yet appeared to be absent in the south of France. In 1839, Decellier records (*Bull. Soc. Ent. Fr.*, 1839, p. ix) 17 larvæ taken at Paris, in mid-September, 1887, in the Faubourg St. Antoine, on cultivated oleanders, all had pupated by October 1st, except one which died. The green colour of the larvæ disappeared by degrees some days before the change to pupæ and the larvæ became of a very deep brown tint. The larvæ and pupæ were kept in the shade under a melon-frame, and the 16 imagines appeared between October 7th and 20th. Lamek reports (*Zool.*, p. 1514) the capture of twenty larvæ at the end of August, 1846, at Flottbeck, near Hamburg. Moeschler notes that, in 1846, larvæ were found in numbers on the oleanders in the "Russian gardens" at Jänkendorf, near Niesky ; Kranz observes that, at Munich, the larvæ pupate about the middle of August, whilst, in other districts, the larvæ are still to be found in September. Stein notes (*Iris*, 1837, p. 104) the larvæ as being bred commonly every year from the oleanders in the gardens of Berlin, a statement that must be received with great caution. Chaumette records (*Zool.*, ix., p. 3159) a larva taken on October 27th, 1844, from the Campagne Villamont at Lausanne. In 1849, the larvæ were again reported (*Bull. Soc. Ent. Fr.*, 1849, p. lxxv) as being very abundant in the gardens of the Luxembourg (Pierret), and considerable numbers were also found at Abbeville (Fairmaire). In 1852, Paris again notes (*loc. cit.*, 1852, p. li) that the larvæ were in great numbers and the oleanders much injured in the neighbourhood of Fourquex, whilst the same year (*loc. cit.*, p. lxxiii) the larvæ reappeared at Epernay and pupated successfully. In 1858 (*loc. cit.*, 1858, p. xviii) a number of larvæ were found at Besançon from which a dozen pupæ were obtained (Bruand). Künckel reported (*loc. cit.*, 1867, p. lxii) finding a larva at the end of August in the dept. of Aisne. In 1885, several were found in various parts of France, and, in 1886 (*loc. cit.*, p. lv), several larvæ were found at Amiens in September. Bartel notes (*Pal. Gross-Schmett.*, ii., pp. 133-134) : "The larvæ attain fullgrowth in from 3-4 weeks, and soon betray their presence on the plants by the quantity they have eaten. . . . . They are to be found from April to June, and again from August to October, mostly on *Nerium oleander*, preferring the flowers ; they grow with extraordinary rapidity, and are usually to be found in some numbers on any plant on which eggs have been laid. Shortly before pupating the larva runs about restlessly, and changes considerably in colour. In central Europe the larvæ frequently perish

of a sickness the origin of which is probably due to the damp cold weather of the summer and autumn nights. The larvæ were taken in some numbers by Standfuss, at Breslau, in August, 1893, on *Vinca major* and *V. minor*, by Borcherding at Bremen, and by Romanoff in Transcaucasia." Hering states that in hot summers the larvæ have been abundant enough in Stettin to do damage to the oleanders in gardens. Caradja notes that his gardener found larvæ in numbers on *Nerium oleander* at Rome, and he surmises that, as the larva will eat *Vinca major* and *V. minor*, the species may become common in central (and perhaps northern) Europe, even to the extent of occurring annually, as does *Manduca atropos* at the present time. Klooss gives (*Ill. Woch. für Ent.*, i., p. 483) the following interesting details of the larval habits: Four eggs and eight larvæ (hatched during the journey) from Malfi (Dalmatia), received July 27th, another egg hatched on the 28th, the other three eggs died. The larvæ were reared the first 10 days in a glass with a double covering of muslin kept constantly somewhat damp. The food at first consisted of the tender terminal shoots of oleander and leaves of *Vinca minor*, carefully cleaned from dust; both plants being greedily eaten, the larvæ growing with extraordinary rapidity. From the 10th day onwards they were placed under a wire-gauze covering at an average temperature of 22° C. and in moist air. Freshly-cut succulent food was given twice a day. They developed a tremendous appetite and fed up rapidly. On August 11th, one larva went under the moss, lying on a layer of sand for pupation, and, on the 16th, the last larva similarly disappeared; the larvæ pupated in from 3-4 days. Swinton notes that the larvæ taken at Jerusalem—both green and brown forms—concealed themselves beneath the leaves of the double garden oleanders in a marvellous way, and so that they could only be discovered by their droppings. Those kept in confinement pupated at the commencement of July and the imagines emerged at the close of the day, between July 21st and 26th. Chaumette records the larvæ as very common at Saugor, in India, on March 3rd, 1865, on *Nerium oleander* and *Tabernaemontana coronaria*. Constant says that the larvæ are sometimes common, and at other times apparently absent, in the Riviera, that, in 1900, they were fairly common from August to December, and that from the pupæ of these some imagines emerged in autumn, whilst others attempted to pass the winter and perished. He says that the larva is easily seen on *Nerium oleander*, that it sits right up on the branches, and, "eating like a rabbit," denudes them conspicuously (*in litt.*), a remarkable observation apparently directly opposed to that of Swinton (*suprà*). Costick records (*Ent. Wk. Int.*, vii., p. 140) the capture of two larvæ of *D. nerii* near Eastbourne, one on October 12th, the other on October 18th, 1859. He states that they fed very well until November, when they became sluggish and ultimately died. He writes: "At first I was inclined to think the larvæ were those of *A. atropos*, the larva of which is sometimes, though rarely, found of a brownish-olive, but, on closer inspection, I observed a difference in the anal horn, that the larvæ were of a lighter green, and that each had two large ocellated spots. They were found in a field of potatoes in which periwinkle grows, and upon which they fed very eagerly just before they died, and also upon the oleander

at times, but when found they were feeding upon potato." The larva figured by Curtis (*Brit. Ent.*, fo. 626) was taken in 1832 at Teignmouth (*Ent. Mag.*, ii., p. 116).

LARVA.—The *young larva* is yellow with a very long black caudal horn (Boisduval). At the time of its *first moult*, the larva is bluish-green, agreeing exactly with the tint of the leaves of the *Nerium*, on which it rests motionless during the day, and is thus difficult to detect. The subdorsal line is broad and yellowish, and extends from the 4th to the 12th segment inclusive. The head is small, concolorous, with three ocellated spots on either side. The legs are washed with carmine at their extremity. The caudal horn is haired throughout its length, and presents three colours—yellowish laterally, black above, with the extremity of the point of a clear white. The stigmata, which are whitish-yellow, are invisible to the naked eye. Below the subdorsal line, from segments 4 to 9, there is a series of whitish dots encircled by azure-blue. The two ocellated spots of the 4th segment, of a bright azure-blue, are already very conspicuous, and, when the larva is disturbed, they increase in brightness, and then acquire a sort of "fulguration" that disappears with the danger. [This peculiarity has not been observed in the adult larva.] The most striking feature of the young larva is the enormous development of the caudal horn on the 11th segment; one might say that this is, in its length, in direct opposition to its smallness in the later larval stadia (Millière). The larva in its *early stages* is yellowish with a strikingly long, finely, but roughly, granulated, black horn. On the sides are ocellated spots which it retains until pupation. *Later*, the larva becomes green or light rose-red, with a slight bluish tinge dorsally. The thoracic segments, the last, and sometimes also the 4th, are either yellowish, citron-yellow, or light green. More rarely the whole body is, according to the age of the larva, orange, ochre-yellow, brown-yellow or bronzy-green. When *fullgrown* the larva measures from 120mm. to 150mm. in length; a large, reniform, blue, ocellated spot with a blue-black margin is situated on the upper part of either side of the 3rd segment; it has a double white pupil, sometimes faintly surrounded by yellow, and occasionally has, instead of the double white pupil, only a bluish-white shade medially. From segments 4 to 11 is a white, light yellow, or full yellow, stripe, running along the sides of the dorsum, and in which appear white dots, surrounded with bluish, whilst above and below this stripe similar dots are scattered over the ground-colour. This stripe is bluish-margined beneath, and, in it, stand the black, yellow-margined spiracles. The true legs are brown-red, in the nearly full-grown larva bluish. Head of the ground-colour. The short and ill-developed caudal horn is thicker below, chiefly citron- or wax-yellow, exteriorly white, and black at the tip, at its base aculeate (Bartel). Elongated and attenuated anteriorly; the three anterior segments retractile (as in larvæ of *Eumorpha elpenor* and *Hippotion celerio*). Head small and globular; caudal horn small, short and thick, and bent backwards, of a pale carrot colour; two large round ocellated spots, bright blue in tint, paler towards the centre, bordered by black, and then surrounded by green on the 3rd segment; the ground-colour is of a pale glaucous-green, inclining to dull yellow on the anterior and posterior segments; a broad lateral white line,

rather ill-defined and marked with round white spots, bordered by dull green, extends on either side from the 5th segment to the caudal horn; the anterior edge of these segments is also marked with several similar spots; the head and the thoracic legs pale green; the membranous prolegs pale greyish-green tipped with brown; stigmata narrow, black, bordered by white; abdomen dull greenish-yellow or greyish-green (Chaumette, *Zool.*, ix., p. 3158). Green, with a prominent, whitish, bluish-bordered, longitudinal lateral band from the sixth segment to base of horn; the band traversed by white oval spots; above and below is a clustered series of white spots, and others bordering the segments over the back; a large purple-centred black-ringed blind ocellus on side of 4th segment; spiracles small, black; horn yellow. Before changing, the larvæ become pale brownish-red, with the black, lateral ocellus, a spot on second segment, and the head dull black, the white lateral clustered spots showing out prominently (Moore). A larva *past 4th moult*, was about 4ins. long, light green in colour (almost sea-green) dorsally, darker laterally, with a white lateral line beginning on the 5th segment, and terminating at the yellow horn. The small, somewhat cleft head, green; on each segment white spots above the white line; the thoracic segments yellowish-green, with a round spot, light blue centrally, darker blue at its margin. The spiracles black, surrounded with a white ring (Nowicki).

Figures of larva of Daphnis nerii.—I. Roesel gives (*Insecten-Belustigung*, vol. iii., tab. xv) three figures of the larva: (1) The first (green) form is green in colour, shading on the 1st abdominal segment into yellow, yellow predominating on the thoracic segments and on the 9th abdominal and horn; the head green. The yellowish-white subdorsal line starts [as all subdorsal (of Weismann) lines of Eumorphids do] from horn and passes forwards, broad and strongly marked to middle of 1st abdominal, *i.e.*, to end of green colouring, being slightly narrower on this segment. The abdominal segments show 9 or 10 subsegments, although fewer are indicated [8 or 9] on figures 2 and 3, but the figures are from different angles, and the subsegmentation of larvæ varies at different parts of segment, and the subsegments seen vary according to how many are obscured at incisions, by attitude of larva. On metathorax are five subsegments and on the first two of these, in line with the subdorsal line, is a large blue eye-spot, partially divided, as if each subsegment had a separate one and these had begun to coalesce. (2) The second figure is of an orange- or brownish-yellow. The subdorsal line white, except that it is yellowish on part of the 7th and 8th abdominals, it proceeds forwards, nearly of the ground-colour from middle of 1st abdominal (yellowish not white), right to the head; head yellow. On the abdominal segments the dorsum is shaded with paler, a darker shade crosses the dorsum of first subsegment, and, from the margin of the light dorsal shade, occupies the next subsegment down to the subdorsal line—of each following subsegment it occupies less, till, on the last (or last but one also), it is absent. Its upper border thus forms an oblique line in reverse direction to that of *Sphinx*, but agreeing with that usual in Nephelids (and some Eumorphids), a similar dark shade occurs below the subdorsal line, extending to below the spiracular level, but interrupted by a yellow area round the spiracle (which is a dark spot). The

eye-spot as in larva 1, except that the 1st member of the eye-spot is the larger, in 1 it is, if anything, rather smaller, the subdorsal line is interrupted by it, the upper margin being about the middle of the spot. The line does not widen or alter, but looks as if it might go straight through unaffected, and had the spot superposed, hiding a portion of it. (3) The third figure is also brown or orange-yellow, but the dark shade of fig. 2 is here very much darker, nearly black, and occupies the whole area dorsal to the subdorsal line (and a little below it as in 2), it also somewhat invades the subdorsal line on the 8th abdominal. Eye-spots the same, two portions equal. The subdorsal line stops at the front of the 1st abdominal. There is a black dorsal plate on the 1st thoracic segment. On all three larvæ are white (shagreen ?) dots along the subsegments, confined to the area that is dark in fig. 2, and invading the subdorsal line on abdominal segments 1, 2 and 3. In fig. 2, the dark shade with dots is shown as breaking through the subdorsal line in the middle of the 3rd abdominal. The eye-spots are blue with black border and central white pupil. II. Sepp gives (*Ned. Insecten*, vol. vi., pl. xxi) two figures (of the same larva?): (4—5) The first is a lateral, the other a more dorsal view, both are green, with a yellowish shade on the thorax, the 1st and 8th to 10th abdominal segments distinctly darker green, just above the subdorsal line. The white dots are fewer than in Roesel's figures; the eye-spots are round, divided by a central subsegmental line; they consist of a black circle, shading through blue into central white, with a yellow line outside. There are 7 subsegments shown in abdominal segments. The subdorsal line stops at anterior margin of the 2nd abdominal. A good deal of the drawing has been done by the colorist (of the hand-coloured plate) and one does not trust it all too much. (6) Sepp figures another (*loc. cit.*, pl. xxii*): Abdominal segments 2, 3, 4, 5, 6, 7 and 8, above the subdorsal line, blackish-green, thorax and 1st abdominal greenish-yellow, 8 (below line) 9 and 10 yellow. A few shagreen-dots shown, and the subdorsal line, (not on 1 but) on the 2nd, 3rd, 4th, 5th, 6th, 7th abdominal segments, shows as consisting of shagreen-dots, closely placed on the subsegmental lines, on 8 it is a white stripe. Eye-spot with yellow outer line and central division, outer margin undivided. III. Dubois figures (*Lép. Belg.*, i., fig. 103?) the only larva he ever took. (7) This is green, with darker shading dorsally, widening to posterior border of segments. The subdorsal line extends to the front margin of 1st abdominal, which is coloured as the other abdominal segments, and shows an abrupt transition to the yellow thoracic segments, a bluish shading below line with a little yellow round spiracles; head green; horn yellow; yellow line on anal plate and 8th, 9th and 10th abdominal; segment otherwise green; 9-10 subsegments; 3rd thoracic shown with 9 subsegments and eye-spot occupies 6 of these (2-7), it is figured as by Roesel but even more double; no white dots are represented; head green. This strikes one as a very honest good figure, if not of good

* Hoffmann (*Raupen Gross-Schmett.*, pl. viii., fig. 3*a*), seems to be obviously a copy (not bad) of Sepp's pl. xxii. Barrett's (*Lep. Brit.*, ii., pl. 53, fig. 1*b*) is a copy of this copy.

artistic finish. IV. Boisduval (*Ic. Chenilles*, pl. iii., fig. 1): (8) A very diagrammatic figure, tolerably uniform smooth green, spiracles with a yellow line round each. Eye-spots very large, single; shagreen-spots shown; subdorsal line white, shown as seven oval (subsegmental) marks on each segment. V. Horsfield and Moore (*Cat. Lep. Ins. Ind.*, i., pl. x., fig. 3). (9) Rather diagrammatic, head and prothorax green, meso- and metathorax yellow, venter and hinder part of body yellow, rest blue!!, with white subdorsal line bordered with yellow above, shagreen-dots diagrammatically indicated, eye-spot in line of subdorsal line. This division of the 1st thoracic into two is shown in several figures, no other shows so great a division of the 3rd into two portions as this. VI. Hübner (*Larv. Lep., Sphinges*, pl. iii., fig. 1): (10) Head green, thorax and 1st abdominal yellow; body green, 8 subsegments shown, horn yellow; white subdorsal line, uniform width, but with incisions of subsegmentation lined through it from horn to anterior border of 2nd abdominal when it stops abruptly; some lilac tinting on green ground-colour below the line; some yellow on prolegs and round spiracles, which are black; shagreen-dots shown, some also, in the line of the subdorsal line, on the 1st abdominal. Eye-spots very dorsal, lower margin level with the lower margin of the subdorsal line; also very double, each portion of about equal size.

Variation of larva.—We have already given notes (*suprà*) of the various forms of the larvæ figured. Swinton records that, at Jerusalem, two forms of the larva were to be obtained—green and brown; Jones also obtained a larva of the brown form at Riva on July 31st, 1900. Treitschke and Kollar note (*Die Schmett.*, x., p. 128) that each of them had had a larva that was of a bronze colour, the front segments rose-red, a dark longitudinal stripe running to the anus; the anus and legs dull rose-colour.

Cocoon.—The larva forms a long silken covering on the ground in which to pupate (Moore). Similarly to most of the larvæ of this group, this species does not enter the ground to pupate, but makes a sort of cocoon with the *débris* of leaves, which it unites with some strands of silk (Boisduval). The larva pupates on the earth in a loose cocoon, mingled with particles of earth and dry leaves (Bartel). Larvæ spun loose cocoons under moss lying on a layer of sand in their breeding-cage (Klooss).

Pupa.—A large pupa, fully longer than *Manduca atropos* but not quite so stout, 2·5 inches to 3 inches in length, this latter measurement would represent a large specimen moderately extended, ·625in. broad. Form much that of a Phryxid or Eumorphid pupa, the 5th, 6th, and 7th abdominal segments narrowing gradually, the 8th, 9th and 10th rather abruptly. The colour is a very pale brown (khaki, terra-cotta or nankeen) with some black markings and a sprinkling of fine black dots. The most conspicuous black marks are round the spiracles (thoracic and on the 2nd, 3rd, 4th, 5th, 6th, 7th and 8th abdominal), forming a row of conspicuous black marks, fairly constant in size, the largest, on the 4th abdominal, being about 2·5mm. in diameter. The colour and markings are very similar to those of the pupa of *Hippotion celerio*. A fine black line runs narrowly down the maxillæ, affecting in front little more than the median suture, posteriorly the whole width of

the maxillæ where they are narrower. There is also a black dorsal line running down the thorax, and, in some specimens, existing more or less on the abdominal segments. The only other black marks that do not appear to belong to the scattered black points are a series of spots, placed subdorsally on the anterior margins of the 3rd thoracic and abdominal segments, varying in intensity in different specimens. The 8th abdominal spiracle is closed, but, otherwise, is as well marked, as to size, structure, and black marking, as the others. The general surface is finely pitted and the pits connected by fine depressed lines, the thorax is smoother and the appendage-cases fairly smooth, the wing-cases well marked by neuration and Poulton's line. Laterally, abdominal segments 5, 6 and 7, where covered and exposed in pupal movements, present areas of a different structure, extending backwards to the spiracles, but narrowing to nothing anteriorly and posteriorly; these surfaces are covered with short transverse ridges, with sharp edges and dark margins, and, where they fade into the general surface, they show by transition that these ridges are special developments of the pupal surfaces between the depressed lines connecting the pits, which arrange themselves transversely as they approach this special area. The anal armature is a short black conical point, 1·5mm. long, ending in a minute double spine. The anal depression is well-marked, the sexual lines less so, but quite distinct. Four pupæ in the possession of M. Constant, one of which was alive (March, 1901) were all affected by two curious defects or malformations. One of these was that the proboscis did not reach the end of the wings by ·25in., leaving an unoccupied gap; the other was that the anterior apex of the 2nd tibia, where it meets the 1st tibia and the antenna, had its point similarly absent, leaving a bare gap or depression (Chapman). The pupa is 58mm. in length, its greatest girth, near the extremity of the wing-cases, being 44mm. It tapers towards both extremities, the head being rather small, but not possessing, as in the case of *Theretra porcellus* and *Eumorpha elpenor*, so pronounced a keel containing the maxillæ. The anal spike is short, and not curved under towards the ventral surface; moreover, the ring of sharp points, found on three of the abdominal segments of the pupæ of the two moths just named, is absent from that of *D. nerii*. The colour is a rich pale sienna-brown, lighter inside the junctions of the segments, slightly darker on the back. The segments have a few scattered small black spots on the back, and on the undersurface also. There is a black streak, in some places quite 1mm. wide, on the thorax along the middle line, but disconnected on the head, and a black spot appears on each side of the head. On the undersurface a black line, ·5mm. wide, extends along the centre, from the base of the wing-cases to the anterior extremity. The antennæ and leg-cases are olive-brown. The spiracles are set in a black spot (Lucas). The slender pupa is brownish-yellow dorsally, with the exception of the wing-cases, and finely dotted with black at the segmental incisions; the spiracles stand in large black spots; the cremaster is short with two fine terminal points slightly curved outwards (Bartel). The pupæ are light brown at first but at the end of 5 or 6 days have become wholly black (Decellier).

Forcing pupæ.—Klooss, who reared this species successfully,

states (*Ill. Woch. für Ent.*, i., p. 483) that the cocoons were spun among moss lying on a layer of sand, that the moss was damped moderately every three days, and that the eight pupæ, which had accomplished their change between August 11th-16th, gave up their imagines on September 14th and the eight following days. Five ♀s and 3 ♂s emerged, all well-developed, the wing expanse varying between 10cm. and 10·7cm., although one specimen measures only 9cm.

FOODPLANTS. — *Nerium* (Linné), *Nerium odoratum*, *Cinchona* (Moore), *Vinca major*, *V. minor* (Standfuss), [*Rumex* (Staudinger) is stated to be an error by Bartel], *Nerium oleander*, preferring the flowers (Bartel), potato (Costick), *Tabernaemontana coronaria* (Chaumette). In Paris almost always on the double-flowered *Nerium odoratum* (Boisduval), *Apocynum venetum*, *Asclepias syriaca* (Bouché).

HABITS.—Very rarely obtained in Britain, and, even in the south of Europe, only occurs as an irregular immigrant in June-July in occasional seasons, the immigrants laying eggs in suitable places and producing a second brood in late September and October, the examples of which, in their turn, also appear to move considerable distances, and to supply us with most of our occasional British captures. Treitschke notes (*Die Schmett.*, x., p. 128) that this migrant was entirely absent from Vienna for several years in succession, but that, from 1829, it occurred every year, and, in the cold and rainy summer of 1833, the larvæ were met with fairly frequently, but not till the end of September and on to the middle of October. Most of these resulted in failure, but Treitschke was pretty fortunate, rearing 11 moths from 15 larvæ, some of which were found when quite small. In favourable years he states that he succeeded in rearing nearly all. The years 1834-5, 1846 and 1885 were exceptionally favourable for the species along the Mediterranean littoral, and, during these periods, the insect was exceptionally abundant at Montpellier, Palermo, Cannes, Nice, Monte Carlo, &c., but it also spread much further north, being found in some numbers at Paris, and in Germany, in Upper Lusatia, the Rhine provinces, &c.* Dormoy, on the authority of Daube, whose observations were made at Montpellier, considers (*Ann. Soc. Ent. Fr.*, 1836, p. 363) that the abundance of *D. nerii* in France, in 1835, was due to the continuance of strong winds from the south in 1834, that he saw imagines some 20 times come to the shore and alight on the first flowers that they encountered, in the latter year, but only when the south wind was driving them, and he suggests that the migrants came from Africa. In the other years, the August imagines were followed by larvæ in September, and such imagines as emerged from the pupæ obtained were produced in November and December of the same year. In 1900 and 1902, again, the species was common on the Mediterranean littoral, but few of the many larvæ obtained produced imagines. Its natural habit, according to Bartel, is to fly to flowers, petunias being noted as the favourite. It is recorded by Winter as hovering over passion-flowers at Brighton (*Zool.*, p. 3624), flying round honeysuckle at Stoke Fleming, just after dusk (Owen), but otherwise the examples in Britain

* Hering and Cornelius give (*Stett. Ent. Zeit.*, viii., pp. 131-140) some detailed notes on its occurrence in Germany (especially about Elberfeld) in 1846.

have been more frequently taken at light or at rest. Thus we have it recorded as: Flying into an open window to light at Brighton (Thorncroft and Tidy), also into a room at Glasgow (Wilson), a ♀ flew into a window at about 6.30 p.m. to light at Yalding (Reid), and at one of the electric lights at Eastbourne (Alford); also it is recorded as resting on an oleander plant at St. Leonards (Smith), on a heliotrope plant in a garden at Aldeby (Winter), at rest on a scarlet-runner plant at Tottenham (Pool), on the stalk of a lily bud at Brighton (Langley), in a garden at St. Leonards (Wood), also at Lewes (Hillman), in a garden at Hemel Hempstead (Piffard), in a garden near Birmingham (Enock), on a sheaf of corn at Barrhead (Grant), on the gatepost of a timber-yard at Hartlepool (Gardner), resting on a pine trunk at Niesky (Moeschler).

Time of appearance.—Imagines are usually taken in temperate Europe (southern and central) in July and September-October, the latter brood being the progeny of the former. In its permanent subtropical habitats in Africa and Asia the species appears to be continuously-brooded, and it is undoubtedly only an immigrant therefrom in the temperate zones of the Old World. The imagines of January-February produce fullfed larvæ in early March (March 3rd, 1865, at Saugor) in India, and these yield imagines again in April. These give another brood of imagines in June-July (July 21st-26th at Jerusalem) which probably represents the earlier immigrants that reach Europe in June and July, earlier or later according to the district whence they have come. Imagines were reared at the end of September, 1834, from larvæ found in mid-August in Montpellier (Paris), also 16 imagines emerged between October 7th and 20th, 1839, from September larvæ, all of which had pupated before October 1st at Paris (Decellier). In 1835, Nowicki bred imagines in November from August larvæ at Thorn in West Prussia, and Siebold, bred one on November 6th from a September larva, taken at Dantzig the same year. In 1885, larvæ were already fullfed in the Riviera from July 15th-30th, from which imagines appeared in August (Millière); in 1893, the larvæ were not fullfed at Breslau until early August (Standfuss), whilst in 1896, eggs, from Malfi in Dalmatia, were already hatching on July 27th-28th, and the imagines emerged from September 14th-22nd. These July imagines, then, give another brood of imagines in September, which, in due course, give the October and November larvæ and the January-February specimens, a brood that never reaches maturity in Europe unless forced *, and then generally emerges somewhat earlier, *e.g.*, December 2nd, 1846, at Paris (Pierret); January 7th, 1887, at Cannes (Warburg), &c. According to Marchal, the larvæ in Mauritius are fullfed in February, April, June, September and December, the imagines appearing in each case about 20 days later (Boisduval). Lederer says that the species always occurs in two generations at Beyrout, the larvæ

* There is considerable evidence that late larvæ rarely reach the pupal stage in Europe, and that when they do they usually die unless forced, *e.g.*, Morres found a fair number of larvæ and pupæ on the Riviera, the pupæ were dug up in February and were dead. Constant obtained four late pupæ (from a considerable number of larvæ, which were common) in 1900, three were already dead in March. In 1902, Powell reared many imagines in September and October at Hyères, a few pupæ went on into the winter but all had died by March, 1903.

in spring and autumn somewhat commonly. In the British Museum coll. are two examples from South Africa, one taken in June, 1896, another in December at Umtali, at 3700ft., by Marshall. The following dates may be of some service: Imagines emerged from September 2nd to end of October, in Prussia (Schmidt), emerged July 21st-26th, 1898, at Jerusalem (Swinton), August, 1885, in the Riviera (Millière), September 14th-22nd, 1896, from Malfi (Krooss), larva pupated mid-August, imago appeared end of September at Sofia (Bachmetjew). Seebold notes (*An. Soc. Esp. Hist. Nat.*, xxvii., p. 119) that, in August, 1885, he took 5 larvæ in his garden at Bilbao, and that these pupated and produced very large imagines at end of October of the same year. The British records to date appear to be as follows: one at Dover about September 6th, 1833, by Miss Herney (Stephens, *Ent. Mag.*, i., p. 525), a ♀ latter end of September, 1834, near Dover pier (Leplastrier *teste* Curtis, *Brit. Ent.*, fo. 626), probably in August or September, 1832, near Netley (Ingram *teste* Curtis, *loc. cit.)*, at Sandown in 1833 (Bromfield, *Zool.*, p. 804), near Barnstaple, date unrecorded (Raddon, *teste* Humphreys & Westwood, *British Moths)*, [Prestwich, 1847 (Crozier coll., *Ent.*, xxiv., p. 195),] September 11th, 1852, at Brighton (*Zool.*, p. 3624), August 16th, 1857, at Brighton (Thorncroft, *Ent. Wk. Int.*, ii., p. 172; Tidy, *Zool.*, p. 5961), ♀ October 26th, 1858, at Aldeby, Beccles (Winter, *Ent. Wk. Int.*, v., p. 42), fine ♀ at Hastings, August 2nd, 1862 (Kent, *Zool.*, p. 8172), September 14th, 1867, at Sheffield (Hydes, *Entom.*, iii., 364), October 12th, 1868, at St. Leonards (Smith, *E.M.M.*, v., p. 172), another (Wood, *Ent.*, iv., 162), [two October, 1868, in Hastings district (Coverdale *teste* Tutt coll.),] ♂ autumn 1869, at Birmingham (Enock, *E.M.M.*, vii., p. 41; *Ent.*, v., p. 144), [August, 1872, at Yarmouth (Colville)], June, 1873, on Ascot racecourse (Studd, *Field*, June 28th, 1873; *Ent.*, xxv., p. 123), [July, 1873, at Strathearn, Crieff (Raynor, *Ent.*, xiii., p. 162), is *in errore* for *D. hypothous*, Cram.], September 3rd, 1874, at Lewes (Hillman, *Ent.*, vii., p. 290), October 13th, 1876, ♀ caught at Hemel Hempstead (Piffard, *E.M.M.*, xiii., p. 138), September 12th, 1884, at Tottenham (Pool, *Ent.*, xvii., p. 233), September 24th, 1884, at Eastbourne (Alford, *Ent.*, xvii., p. 233), November, 1884, at Blandford (Jeffreys, *Ent.*, xvii., p. 273), July 23rd, 1885, at Hartlepool (Gardner, *E.M.M.*, xxii., p. 89; *Ent.*, xviii., p. 218), larva obtained August, 1885, at Porchester, reared and an imago obtained by Russell (Pearce, *Ent.*, xxiv., p. 92), [Prestwich, 1886 (Melvill, *Ent.*, xxiv., p. 195),] September 7th, 1886, in Kensington Gardens, Brighton (Langley, *Ent.*, xix., p. 250), September 10th, 1886, in Glasgow (Wilson, *Young Nat.*, vii., pp. 212, 230), September 20th, 1888, at Poplar (Briggs, *Ent.*, xxi., pp. 258, 265), [October, 1888, on London Bridge (Hollis, *Ent.*, xxii., p. 120),] [one exhibited by Mason, taken at Burton-on-Trent, at a meeting of *Ent. Soc. Lond.*, Oct. 3rd, 1888 *(E.M.M.*, xxv., p. 143),] September 26th, 1890, at Stoke Fleming* (Owen, *E.M.M.*, xxvi., p. 328; *Ent. Rec.*, i., p. 238), end of July 1896, at Stowting (Upton, *Ent.*, xxix., p. 316), September 19th, 1896, near Aberdeen (Horne, *Ent. Rec.*, ix.,

* Morres has again recorded (*Ent.*, xxviii., p. 332; *Ent. Rec.*, viii., p. 273), this specimen as coming from Stoke Henning instead of Stoke Fleming (see Barrett, *Ent. Rec.*, ix., p. 41).

p. 63), ♀ September 18th, 1900, at Yalding (Reid, *Ent. Rec.*, ix., p. 303; *Ent.*, xxxiii., p. 305), September 24th, 1900, ♀ taken at Chickerell, by Mrs. New (Richardson, *Ent. Rec.*, xii., p. 303; *E.M.M.*, xxxvi., p. 260), imago at Teignmouth *, October 23rd, 1900 (Evans, *Ent.*, xxxiii., p. 352), end of September, 1900, at Barrhead (Grant, *Ann. Scot. Nat. Hist.*, 1901, p. 52), September, 1900, in Bishopsgate Street (Sandford, *Ent. Rec.*, xii., p. 347).

LOCALITIES.—The following are the localities where examples have been taken in Britain: ABERDEEN: Aberdeen (Horne). BERKS: Ascot (Studd). DERBY: Burton-on-Trent (Mason). DEVON: Stoke Fleming, near Dartmouth (Owen), Teignmouth (Evans), near Barnstaple (Raddon *teste* Humphreys & Westwood). DORSET: Chickerell, near Weymouth (Richardson), Parkstone (*teste* Bankes), Blandford (Jeffreys). DURHAM: Hartlepool, once (Gardner). ESSEX: Poplar (Briggs). HANTS: near Netley (Ingram *teste* Curtis), Porchester (Russell *teste* Pearce), Sandown (Bromfield). HERTS: Hemel Hempstead (Piffard). KENT: Dover (Stephens), Yalding (Reid), Stowting (Upton). LANARK: Glasgow (Wilson). LANCASHIRE: Prestwich (Melvill). MIDDLESEX: Tottenham (Pool). NORFOLK: Yarmouth (Colville). RENFREWSHIRE: Barrhead (Grant). SUFFOLK: Aldeby, near Beccles (Winter). SUSSEX: Hastings (Jenner), Brighton (Thornycroft), Eastbourne (Costick), St. Leonards (Wood), Lewes (Hillman). WARWICK: Birmingham (Enock). YORKS: Sheffield (Hydes).

DISTRIBUTION.—This is a tropical and subtropical species, distributed throughout Africa and the southern parts of Asia, extending into Europe and temperate Asia at irregular periods, imagines being picked up here and there throughout Europe, whilst occasionally a ♀ lays her eggs and the larvæ produce a late brood of imagines; the species appears, however, to be quite unable to winter in any stage, except in the hotter parts of its range. AFRICA: the whole of Africa (Boisduval), Western Africa, Grand Bassam (Harker), Sierra-Leone—Freetown (coll. Oberthür), Azores (Godman), the Cauaries, Southern Nigeria, Nyassaland (coll. Brit. Mus.), Umtali (Marshall), Delagoa Bay (coll. Oberthür), Natal, rarely (Spiller), Durban (Leigh), Zululand (Slater), rather common at Mozambique, Bourbon, Mauritius and Madagascar (Boisduval), Comoro Islands (Humblot). ASIA: Asia Minor—between Turbaldy aud Smyrna (Staudinger), Beyrout, fairly common (Lederer), Aden (coll. Brit. Mus.), India—Silhet (coll. Boisduval), Saugor, very common (Chaumette), Coromandel Coast (Cramer), Trichinopoly (Castets), Bengal (Boisduval), Madras, Old Calabar, Ceylon (coll. Brit. Mus.), East Indies (Horsfield), Java (Crauer). EUROPE: AUSTRO-HUNGARY: Tyrol, very rare—often not rare at Botzen, *e.g.*, 16 taken in 1863 (Hinterwaldner), Innsbruck, Taufers Valley, only in hot summers, *e.g.*, 1857, 1869 (Weiler), Bukovina, only in the lowlands (Hormuzaki), Pressburg, in 1874, 1875, 1876, 1877 (Rozsay), Bohemia—Steinitz, one, Budweis and Elbogen district, several larvæ in 1846 (Nickerl), Augsburg, Prague, Asch, Vienna, Linz, Aschach, Sirning, Salzburg, once, Carniola, Buda (Speyer), Innsbruck, 8 larvæ, September 13th-15th, 1872 (Weiler), Hermannstadt, larvæ, 1866, Kronstadt, larvæ, 1890, not indigenous (Czekelius), Eperies, not since 1875 (Husz), Salzburg, some years ago (Nickerl), Dalmatia, Zara (coll. Oberthür). BELGIUM: Brussels, Louvain, Namur (Donckier). BULGARIA: Sofia (Bachmetjew). FINLAND: Ryska Karelen (Günther). FRANCE: common throughont the Mediterranean littoral, accideutally only in other parts of France (Berce), near Caen, one (Fauvel), Douai, two only (Foucart), Berry and Auvergne, accidentally (Sand), Eure-et-Loir, accidentally in certain years (Guenée), Haute-Garonne—occasionally between 1859-1865, larvæ on oleander in gardens (Caradja), Digne, Marseilles (Dardoin), Toulon (Speyer), Var (Cantener), Gironde—Talence, Bordeaux (Trimoulet), Loire-Inférieure, one or two (Bonjour), Sarthe (Desportes), Cannes, Nice, Monte Carlo (Millière), Hyères (Meissonier), Epernay, Montpellier (Paris), Pont Saint Esprit (Blanc), dept. Aisne (Küuckel), Chartres (Lesage), Abbeville (Fairmaire), Fourquex (Paris), Besançon (Bruand), Amiens (*Ann. Soc. Ent. Fr.*, 1886, p. 55], Nantes, Le Pau, Lignières, Gourieux,

* Lake notes (*Ent.*, xxxiii., p. 352) an example taken about 50 years ago (*i.e.*, 50 years before 1900) at Teignmouth. This was not so; a larva was taken there in 1832, but died (see *Ent. Mag.*, ii., p. 116; Curt., *Brit. Ent.*, fo. 626).

Champrosay, Turbé, Raincy (Fallon, *Le Nat.*, 1885, nos. 21-24), dept. du Nord, occasional visitor (Paux). GERMANY: Only as an immigrant (Heinemann), southwest Germany in years 1834, 1842, 1846, 1847 and 1852, at Frankfort, Hauau, Darmstadt, Wiesbaden (Koch), West Prussia — Thorn (Nowicki), Dautzig (Siebold), Rhine Palatinate, in certain years (Bertram), Würtemberg, occasionally, not since 1834 (Seyffler), Giessen, several larvæ one summer (Dickore), Lower Elbe district—banks of the Elbe (Zimmermann), Erfurt, in 1834 and 1859 (Keferstein), Munich, in gardens, very rare (Kranz), Hesse-Darmstadt, two iu 1846, common in 1852 (Glaser), Lower Elbe district—Altoua, larvæ September, 1859, produced imagines October-November, 1859 (Semper), Meckleuburg, commoner in the '70's than earlier—Ludwigslust, Schwerin, Bützow, Hageuow (Schmidt), Bremen, 4 in 1854, larvæ numerous in 1870, Oldenburg, once (Rehberg), Saxon Upper Lusatia—Bautzen, several larvæ in September, 1877 (Schütze), Dresden, only as a visitor (Steinert), Thuringia, singly in hot years—Jena, Arnstadt, Sondershausen, Gotha, Erfurt, Coburg (Krieghoff), Prussia, not altogether rare, larvæ frequeutly (in 1852 abundant) at Kahlberg, Königsberg in 1861, Braunsberg, singly (Grentzeuberg), Upper Lusatia—Niesky, twice (Moeschler), Jankendorf, Anclam (Homeyer), Silesia, a migrant—Domanze, Breslau (Assmann), Nassau, several, Wiesbaden, oue August 7th, 1852, Mayence, Rheingau (Rössler), Ratisbon, accidental visitor, occurred in 1884 after long absence (Schmid), Posen, Frankfort-on-Oder, Magdeburg, Eschwege, Barmen, Aix, Mayence, Strassburg, Aschaffeuburg, Nuremburg, Passau, Metz (Speyer), Pomerania—Stettin, Greifenhagen, Swinemüude (Hering), Dessau, larvæ often found in 1826, 1835, 1836 and 1847 (Richter), Alsace, abundant certain years, *e.g.*, 1857, 1874 (Peyerimhoff), Brunswick, abundaut 1846 (Heinemann), Hanover, imagines very rare, larvæ sometimes abundant in hot summers (Glitz), Frankfort-on-Oder, a few (Kretschmer), Lübeck (Paul), Berlin district occasionally (Pfützner), Chemnitz, a visitor (Pabst). GREECE: Attica, Corfu, Tinos (Staudiuger), Crete (Lucas). ITALY: not common (Curò), Modeua (Fiori), Sicily, one (*Nat. Sic.*, iv., p. 32), Roman Campagna, rare—Florence, Pisa, Leghorn, Lucca, also larvæ iuside walls of Rome (Calberla), near Palermo (Curò), Riva (Jones), Genoa, Turin commou (Duncan). NETHERLANDS: Gröningen, three, Soestdijk in Utrecht, near Haarlem, and Amsterdam in N. Holland, Rotterdam in S. Holland, as larva and imago, Lemburg, Zwolle, one, September, 1874 (Snellen). ROUMANIA: Husch, one, iu June, Bucarest, &c. (Caradja). RUSSIA: Baltic provinces—Dorpat (Sintenis), numbers bred in Riga 1877, 1882 (Teich), Esthonia—Poenal, one (Frese *teste* Petersen), Crimea (Meliorausky), Transcaucasia—Borjom, in July, rare (Romanoff). SCANDINAVIA: has occurred at Gothland, Russian Karelia (Aurivillius), once at Christiania (Siebke). SPAIN: Audalusia, Cadiz (Staudinger), Galicia, rare—Santiago (Macho-Velado), Barcelona (Cuuí y Martorell), Catalonia (Martorell y Peña), Bilbao, 5 larvæ, August, 1885, bred October (Seebold). SWITZERLAND: Grisons—Reichenau (Killias), Campagne Villamont at Lausanne (Chaumette), Geneva (Fallou). TURKEY: Constantinople (Treitschke), Crete (Lucas).

Subfamily: SPHINGINÆ.

It has been generally accepted that this subfamily is the most highly specialised of the Sphingids. In certain ways this is true, as the larvæ, pupæ and imagines are, at least in some genera, *e.g.*, *Agrius*, &c., exceedingly highly specialised. But further study of the group shows that this is not so in all cases, and some species that must, on our present knowledge, be placed in the *Sphinginae* are very fairly generalised forms. Nor is the general opinion, that the subfamily (as distinguished from the Eumorphids and Amorphids) is well-defined, at all true, for the lower members of the group—*Ceratomia*, *Daremma*, &c.—are not too decidedly free from Amorphid features. The actual relationships of the Sphingids and Amorphids, also, are not at all too clear, and, the more one investigates the subject, the more one is inclined to unite the Sesiids, Eumorphids, Philampelids, &c., into one group, and the Sphingids and Amorphids into another. It is true that the *Sphinginae* are specialised much in the direction of the higher Eumorphids *(sens. lat.)*, but they have also many characters placing

them in alliance with Amorphids, of which, possibly, one of the most cogent is the remarkable similarity of the larval markings. It is, indeed, difficult to place some of the more primitive groups, which might with equal propriety be placed in either of these divisions, and yet are not clearly of sufficient value to be given separate rank—*e.g.*, *Darapsa*, *Ceratomia*, *Deidamia*, *Gurelca*, *Daremma*, &c., of which *Ceratomia* and *Daremma* incline to the Sphingid and the others to the Eumorphid side. Chapman states *(in litt.)* that the pupæ of the lower Sphingids are not always easy to differentiate from those of the lower Eumorphids or Amorphids, a statement that we have already noted as being probably, in some degree, true of them in other stages. This difficulty, he says, "is increased when one has only dead pupæ to deal with, but, if we accept *Ceratomia amyntor* as a Sphingid *(sens. restr.)*, and, in this, we see no difficulty, then we may have the labrum ventral and no tongue-horn present. If *Daremma undulosa* be a Sphingid *(sens. restr.)* which is perhaps more doubtful, then we may have a Sphingid *(sens. restr.)* pupa hardly to be differentiated from that of an Amorphid. The primitive Sphingid *(sens. restr.)* must, however, have had a pupa almost identical with that of *Amorpha*. If *D. catalpae* be a Sphingid *(sens. restr.)* and our pupæ are correctly named, then a Sphingid *(sens. restr.)* pupa may be, in all respects, like that of an Amorphid, with the wings meeting in front. As our specimens are not dehisced, we cannot say whether it has attained the true Sphinx character, of not slitting the mesothorax on dehiscence, but there is no sign of a suture. The more developed Sphingid *(sens. restr.)* pupa appears to present two forms, one of which may be typified by those of *Hyloicus pinastri* and *Sphinx ligustri*, and is the less specialised. This pupa is fairly straight and fairly cylindrical, and the prespiracular flange of the 5th, 6th and 7th abdominal segments is fairly developed. The proboscis-horn or -case is generally short and simple and pressed close to the front of the pupa. The pupa of *Agrius convolvuli* tends rather to belong to the following section, but is somewhat intermediate. This second form, the more developed Sphingid *(sens. restr.)* pupa, may be represented by *Phlegethontius*, *Macrosila* or *Amphonyx*. In these, there is a good deal of antero-posterior flattening and a certain amount of the S-curving characteristic of the similarly flattened pupæ of *Sesia (Macroglossa)* and some Eumorphids. The flanges of abdominal segments 5, 6, 7 are well developed and the horn of the proboscis is largely developed and may be variously curved or coiled. The prothoracic callosity is well-developed and similar roughnesses may be present on the abdominal segments. In the most developed of these, the labrum is quite anterior, but never makes any approach to the fully dorsal situation it occupies in fully evolved Eumorphid pupæ. The pupa suggests that *Manduca* is an *Amphonyx* in which the proboscis-case has receded again. In form and outline, callosities and spiracular flanges, it fully agrees with the higher Sphingids. Looked at from this point of view, one may doubt the right of *Manduca* to rank as a separate subfamily. Amorphines, Hemarines, Pterogonines, Sphingines, Eumorphines, Philampelines, Sesiines, and probably others, all left the original stirps very early and nearly together, Eumorphines, Philampelines and Sesiines (with some other of the old Macroglossid and Chœrocampid families) probably

keeping together appreciably later, but, from a Manducine standpoint, they were all ancient and well-established families before *Manduca* was heard of. *Manduca* is derived from some well-advanced Sphingine, and is not very distantly related to some such form as *Amphonyx* or *Macrosila*, the chief difference being that the plasticity in the maxillary development was here very great, and permitted evolution to take place in two such opposite directions as *Manduca* and *Macrosila*, both, however, having a common ancestor at about the developmental level of *Agrius convolvuli*. *Manduca* preserves, in the pupa, a file-like rough area representing the proboscis-horn of the higher Sphingids, the rest of the maxilla being, as in them, smooth. The character which may best be relied upon for the division of the Sphingids *(sens. restr.)* from the Amorphids is the possession by the Amorphids of a dorsal metathoracic suture in the pupa that is functional on dehiscence. This does not occur in the Sphinges (or Eumorphids). The more typical Sphinges, have, in the pupa, a horn for the accommodation of the proboscis. This always develops before the face-parts are pushed much upwards and backwards, so that the labrum, ceasing to be ventral, barely reaches an anterior position before relief is afforded by the development of the horn, and the labrum never becomes dorsal, as it does in the Eumorphids, long before a horn appears. Larvally, the Amorphids and the Sphingids must be associated: (1) In possessing a much less primitive first stage than the Eumorphids. (2) In presenting the same pattern of oblique stripes. In Eumorphids, oblique stripes are not rarely developed in a reverse direction to that in which they occur in Sphinges. Occasionally, however, they appear in definite Sphingine manner, of which a notable example is figured by Poulton *(Trans. Ent. Soc. Lond.*, 1887, pl. x., fig. 3). Our present knowledge gives us apparently no ground for any theory of such stripes in Eumorphids, than that they are developed quite independently of any common origin with those in the Sphingine line. The subdorsal line, originating at the horn of the lower forms of Sphingid larvæ, presents, on the 8th abdominal segment, a basis for the development of an oblique stripe, that may, quite possibly, therefore, arise in two different divisions of the *Sphingides* *. There are two different groups of Sphinges, usually placed in *Sphingidae*, whose right to be there may be seriously questioned. One of these is that containing *Kentrochrysalis* as a central form. The larva of this is said much to resemble that of *Phyllosphingia dissimilis*, an undoubted Amorphid, and the pupa is clearly Amorphid, presenting no feature in common with *Hyloicus*, which the imago certainly very considerably resembles. Along with *Kentrochrysalis* would probably go *Sphingulus*, and, perhaps, one or more species placed in *Dolbina*, but our information about the early stages of these is too defective either to support or contradict such a surmise. It may be noted

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* The Hemarid larva has rudiments of both the subdorsal and spiracular series of stripes; they are rather colour-shadings than stripes, as we use the term in relation to the larvæ of Amorphids and Sphingids *(sens. restr.)*, but requiring little development to make them so; the series slope in opposite directions, the subdorsal as in Sphingids and the spiracular as in the Eumorphids. In the Eumorphids the stripes are only spiracular, whilst in the Amorphids and Sphingids they cover both areas, but one suspects them to be of subdorsal origin (Bacot).

here, that the longitudinally-striped larva of *Hyloicus pinastri* has no relationship with the similarly striped larvæ of the lower Eumorphids, but is a specialisation, and that it doubtless had ancestors striped in true *Sphinx* manner. The other genus, very probably erroneously referred to *Sphinginae*, is *Dilophonota*. The larva of this genus has no Sphingine characters, but is decidedly not very far from the Eumorphid type as shown in *Acosmeryx*, *Philampelus* and *Pachylia*. The pupa is also quite Eumorphid. The imago has a facies quite different from anything else, but presents a few characters (of neuration, &c.) that suggest that its Eumorphid affinities are in some way viâ *Thyreus*." For our views of this see *posteà*, p. 273. Weismann, discussing the larvæ of the Sphingids (*sens. restr.*) and Manducids, writes (*Studies in Theory of Descent*, transl. p. 261): "Of the genera mentioned, I am acquainted altogether with fourteen species of larvæ—*Macrosila hasdrubal* (*Pseudosphinx tetrio*), *M.* (*Protoparce*) *cingulata*, *M.* (*P.*) *rustica*, *Sphinx* (*Agrius*) *convolvuli*, *S. ligustri*, *S. carolina*, *S. quinquemaculata*, *S. drupiferarum*, *S. kalmiae*, *S. gordius*, *Dolba hylaeus*, *Acherontia* (*Manduca*) *atropos*, *A. styx* and *A. satanas*. With one exception all these caterpillars possess oblique stripes of the nature of those of Smerinthid larvæ, and most of them are without any trace of a subdorsal line; one species, the North American *M. cingulata*, has a completely developed subdorsal, and the typical European species, *S. convolvuli*, has a rudimentary subdorsal line. The ground-colour, in most of these species, is of the same green as that of the leaves of their foodplants; some are brown, *i.e.*, earth-coloured, and, in these, the markings do not appear so prominently; others, again, possess very striking colours (*A. atropos*), the oblique stripes, in these cases, being very vivid. Only *M. hasdrubal* (*tetrio*) separates itself completely from this system of classification, since this species is deep black with narrow yellow rings, the horn and last segment being red. The large and most striking larva of *M. hasdrubal* (*tetrio*) is the same of which Wallace has made use for his theory of the brilliant colours of caterpillars. The explanation of the origin of this widely divergent mode of markings could only be furnished by the ontogeny, in which one or another of the older phyletic stages will certainly have been preserved." Meldola observes (*loc. cit.*, p. 262, footnote) that larvæ of many other species have been figured by Butler, most of which fall under Weismann's remarks, but *Pseudosphinx cyrtolophia* has very divergent marking, a broad white dorsal line bordered with pink, and two large pink ovals on the back of the four anterior segments, the hinder and larger of these being bisected by the dorsal line. With reference to the larva of *M. atropos*, Mansel-Weale states (*Proc. Ent. Soc. Lond.*, 1878, p. v) that, in South Africa, the ordinary form feeds generally on *Solanaceae*, whilst the darker and rarer variety is found only on species of *Lantana*. Of those species figured by Burmeister, Meldola notes that the larva of *Protoparce albiplaga* is pale green with large yellow black-bordered patches surrounding the spiracles, whilst those of *Pseudosphinx tetrio* and *Anceryx scyron* are black, with broad transverse belts, yellow and white respectively, encircling the middle of each segment. These light bands serve very effectually to break up the uniform surface of the large bodies of these insects. Weismann concludes that the *Sphinginae* are a younger group than the *Smerinthinae*, since, in the former,

the oblique stripes have reached a higher development, being always of two, and sometimes of three, colours (*e.g.*, *drupiferarum*—white, red, and black), whilst in the species of *Smerinthus* they only occasionally possess uniformly-coloured borders.

We have already dealt with the larval structure of the Sphingids (*sens. restr.*) (taking *Sphinx ligustri* and *Agrius convolvuli* as types) (*anteà*, vol. iii., pp. 367-368). The only point to repeat is that, in the 1st instar, the primary tubercles agree in their arrangement with those of the Sesiids and Amorphids, *i.e.*, tubercles i and ii on the abdominal segments form the typical trapezoidals, but on the meso- and metathorax they arise from a single plate or raised area, whilst iii forms the typical supraspiracular, iv is subspiracular, and there is a prespiracular (which is said by the authorities to be v, moved forwards and upwards) quite at the front of the segment, vi being nearly at the base of the proleg *. One of the most interesting features of the newly-hatched larva is the absence of shagreen-tubercles and secondary hairs, which appear suddenly at the 1st moult, and are retained throughout larval life, although they gradually atrophy, but yet can still be traced in the last stadium in the species examined. The structure of the caudal horn is interesting from the fact that it is thickly clothed with short bifurcate hairs, whilst the tip carries two setæ corresponding with those arising from tubercles i on the other segments, these setæ being somewhat enlarged, funnel-like apically, and with traces of spiculation. The caudal horn has no doubt originated as a raised area, bearing the two tubercles i, which has gradually developed and risen until it has assumed the character of a horn, always carrying on its summit the two tubercles, distinct but varying in position, probably at first with something of the double character now seen in the horns of the larva of *Lophopteryx camelina*, coalescing, however, and forming a common base long before being so well-developed (separately) as that of the latter species. In the larva of *Agrius convolvuli*, Poulton notes (*Trans. Ent. Soc. Lond.*, 1888, p. 519) that the bifidity of the horn varies immensely in the 1st larval instar, is somewhat shorter than, but is covered with hairs somewhat similar to those on, that of *Sphinx ligustri*. There appears to be no doubt that the bifurcation of the horn, which is common throughout a great many very different sections of the Sphingids (*sens. lat.*), is quite a primitive and ancestral feature. Poulton connects (*loc. cit.*, 1885, p. 303) the use of the horn with the longitudinal markings exhibited, and states that the horn in *Sphinx ligustri* and *Smerinthus ocellata* exhibits movements synchronous with the contractions of the dorsal vessel. The development of the typical longitudinal lines and oblique stripes during the growth of the larva in the 1st instar and before the 1st moult may also be mentioned.

Among the lower *Sphinginae* the larval structure offers consider-

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* The hopelessness of using some of Poulton's early work is amply demonstrated by comparing the above description with his figure of the newly-hatched larva of *Sphinx ligustri* (*Trans. Ent. Soc. Lond.*, 1885, pl. vii., figs. 1-2); on the other hand, his drawing of the larva of *Agrius convolvuli* (*loc. cit.*, 1888, pl. xv., fig. 2) is very fairly accurate, except possibly in the dorsal thoracic setæ, that do not show the arrangement of rising from a common base common to the higher *Sphinginae*, whilst vi is missed altogether.

able variation. Thus the newly-hatched larva of *Ceratomia amyntor* is described by Fernald *(Sphingidae of New England*, p. 115) as having a pair of minute thoracic horns on the top of the 3rd segment and another pair on the top of the 4th, whilst there is a row of minute fleshy teeth along the middle of the back, which are scarcely visible. Like many of the higher *Sphinginae*, it develops its characteristic markings before the 1st moult, and assumes its covering of secondary shagreen-hairs at the first ecdysis, this latter it retains until adult, and, when fullgrown, "has a dorsal row of fleshy teeth, one on each wrinkle, tipped with whitish or pink, extending from the 4th segment to the caudal horn; there is also a pair of short straight tuberculated horns on the top of the 3rd segment and a similar pair on the 4th.

As to the larval markings, Weismann has attempted to discuss them *(Studies in the Theory of Descent*, pp. 259 *et seq.)* but he is wanting entirely in first-hand knowledge, except in the case of *Hyloicus pinastri*, a species that, in the larval stage, is very different from the characteristic type of the subfamily, but, on the strength of the figures of certain species (already detailed, *anteà*, p. 266), he concludes that the subdorsal line was the primary marking, this line being subsequently entirely replaced by the oblique stripes. He further suggests that the *Sphinginae* are a younger group than the *Amorphinae*, a conclusion which he considers, as we have also already noted, to be borne out by the fact that, in the former, the oblique stripes have reached a higher development, being always of two, and sometimes even of three colours *(Sphinx drupiferarum*—white, red, black), whilst, in the Amorphids, they only occasionally possess uniformly coloured borders. Weismann's work with regard to the markings of the Amorphid larva *(loc. cit.*, pp. 232 *et seq.)* is more satisfactory, but much detail is missed, and only the broadest general features are discussed, whilst his conclusions, with regard to the adaptive nature of the markings *(loc. cit.*, pp. 320 *et seq.)*, are probably as correct as anything since formulated. Poulton, who followed up this line of enquiry, made a number of detailed observations (some of which are, unfortunately, not quite accurate) which were published between 1884 and 1888 *. In his first paper, he utilised Weismann's remarks on the part played by the modification of the shagreen-spots in the formation of the prominent pale markings in certain Phryxid larvæ, so far as to apply them to the formation of the characteristic Sphingid and Amorphid markings, and to show that the oblique lines of the Amorphid larvæ originated as enlargements of the shagreen-dots, and that the effect has been increased by the ground-colour becoming gradually lighter along the same lines *(Trans. Ent. Soc. Lond.*, 1884, p. 32). He further notes *(loc. cit.*, p. 36) that the shagreening in the larva of *Sphinx ligustri* is exactly like that of the Amorphid larvæ, and states that, in the last stadium, the white stripes of the former retain indications of the shagreen-spots on their anterior inferior extremities, which

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* (1) *Trans. Ent. Soc. London*, 1884, pp. 27 *et seq.* (2) *loc. cit.*, 1885, pp. 281 *et seq.* (3) *Proc. Roy. Soc. Lond.*, xl., pp. 135-173. (4) *Trans. Ent. Soc. Lond.*, 1886, pp. 137-179. (5) *loc. cit.*, 1887, pp. 281-321. (6) *loc. cit.*, 1888, pp. 515 *et seq.*

are made up of scattered white points, and he recounts certain observations which tend to show that the purple borders of the stripes in this species have been modified from a dark green border at the sides, but not above, where the latter faintly persists; in the same manner, the pure white stripes have arisen from lines, like those of the Amorphids, which still remain above. He concludes that the beautiful colours of *Sphinx ligustri* have been acquired very late in the phylogeny. In a later paper (*loc. cit.*, 1885, pp. 281 *et seq.*), Poulton details the ontogeny of *S. ligustri*, and makes an erroneous guess* (p. 283) that the larva of this species, which has a clothing of short secondary hairs in its 2nd instar, also has them in its 1st, and he later (*loc. cit.*, 1886, p. 141) refers to this as an observed fact. This and other errors of observation tend to discount the value of much otherwise good work. We have already (*anteà*) referred to the subdorsal line as a characteristic feature of the more generalised Sphingid larvæ and as occurring in the early larval stages of many Eumorphid (*sens. lat.*) larvæ that lose it more or less in their later and more highly specialised stages. Weismann points out (*Studies in the Theory of Descent*, transl. pp. 242, 317, 372) the relationship of this line with the more recent and special-

* In spite of the detail into which Poulton enters in the papers already referred to, they are defective and even inaccurate from many points of view (due largely to the fact that he had not the advantage of knowing the importance of the position of the primary tubercles which Dyar has since shown), and they must be considered as useful only for the purpose of tracing the development of the larval markings, and not to be relied upon in the references to detailed structure. His description of the primary tubercles in *Sphinx ligustri* (*Trans. Ent. Soc. Lond.*, 1885, p. 282) accounts for i, ii, iii on abdominal segments 1-7, but leaves out entirely iv, v, vi; even then he erroneously states that iii is composed of two setæ, and he further notes that, on abdominal segments 8-10, the setæ are more abundant and without definite arrangement. He also states (p. 283) that he did not examine for "small" hairs in stage 1, but since he found them in stage 2 he assumed that "there must be a comparatively thick coating of them" in the 1st stage, and then deals with them as if they were present, remarking that "there can be no doubt of their presence," &c., whilst we read yet again of the presence of these hair-bearing shagreen-dots in the 1st instar of *S. ligustri* (*loc. cit.*, 1885, p. 299), in fact, the larva of this species, and that of *S. ocellata* in the same stage, are described as "hairy larvæ with tubercles at the bases of the hairs." As a matter of fact, these small hairs do *not* appear in the 1st instar of *S. ligustri*. Similarly we find him uncertain (*loc. cit.*, 1888, p. 520 whether shagreen-dots appear at the end of the 1st instar of *Agrius convolvuli*, or whether they are merely those of the 2nd instar showing through the transparent skin just before the 1st moult. Further, he did not, until 1884, demonstrate the presence of the well-known bifid hairs in the Amorphids, although he had been publishing his observations on the larvæ of this group in 1883, and even then (in 1884) did not detect them until the 3rd larval instar, thus showing that the work was done with an altogether too low power to deal with the detail attempted. As late as 1886 (*loc. cit.*, 1886, p. 141), a comparison between the first stages of *Smerinthus* (*ocellata* and *populi*) and *Sphinx ligustri* is made, and the error that the newly-hatched larva of *S. ligustri* is covered with hairs or bristles springing from ordinary shagreen-dots is yet again repeated, whilst he further states that the dorsal and lateral rows of hairs (= those arising from i, ii, iii) spring from larger shagreen-dots, a most remarkable statement as to the origin of primary larval setæ. In his uotes on the larva of *Agrius convolvuli* (*loc. cit.*, 1888, p. 520) he also treats the primary tubercles, i to vi, as shagreen-tubercles, and states that, in the 1st instar, "there are at first no other shagreen-tubercles upon the larva." Altogether, whilst recommending the perusal of these papers for their general account of the development of the Sphingid larval markings, we would suggest that the student should compare carefully all statements relating to details of larval structure with the details under the several species published in this work (*anteà*, iii., pp. 386 *et seq.*) before accepting the same.

ised oblique stripes, in the Amorphids, and asserts that the tendency is for the larvæ to lose this subdorsal line as the development of the oblique stripes proceeds, and he suggests and fairly proves that the replacement of the subdorsal by the oblique lines is a comparatively recent feature in the evolution of the Amorphid (and Sphingid) markings. Poulton sees *(Trans. Ent. Soc. Lond.*, 1884, p 32), in the remains of the subdorsal line, a more efficient means of protection when a larva is at rest in the Sphinx attitude, for then, the subdorsal line, following the curved anterior segments, becomes approximately parallel to the oblique stripes *(loc. cit.*, pl. i., fig. 4). So many Sphingid (*sens. restr.*) larvæ still have traces of the subdorsal line that he considers that its entire absence in others must be looked upon as a very recent line of development, *e.g.*, *Agrius convolvuli*, *Manduca atropos*, &c., retain this line throughout their ontogeny, and *Sphinx ligustri* has it well-developed in its early stages. The shagreen-spots, as we have already pointed out, are, in reality, tiny patches of pale colour developed at the bases of the secondary hairs, and are characteristic of many Sphingid larvæ—Sesiids, Phryxids, &c.—and not at all restricted to those of the *Sphinginae*. Usually, these appear in the earlier stadia in their simplest forms and become modified into special markings in the later stadia, but, in the *Sphinginae*, as exemplified in *Sphinx ligustri* and *Agrius convolvuli*, the shagreening does not appear until the second instar, although the pale specks on the new skin may be seen through the old skin just before the 1st moult. It is quite possible that the smooth 1st instar of the *Sphinginae* is evidence that the larvæ of this subfamily are less specialised than those of the Amorphids, where the shagreening has been pushed back into stage 1, and really develops on the larva before it leaves the egg. The spiculation of the caudal horn on the *Sphinginae* in the 1st instar may, of course, be the remains of a previous general spiculation in that stage (in which case the above view of the Amorphids being more specialised would be erroneous), or it may be a highly specialised part of the larva which has received spiculation from the following stage, but which the rest of the surface has resisted, but which has been submitted to in the more specialised Amorphids. The tiny little mammillæ bearing the setæ that arise from these pale specks are generally known as shagreen-tubercles and must not be confused (as Poulton has evidently done, *antea* p. 269, footnote) with the primary tubercles, i, ii, iii, iv, v, vi, &c., which are chitinous-based in their most simple forms. The importance of these shagreen-spots in the development of the larval markings has already been referred to, and is readily followed by a study of the ontogeny of the Phryxid, Sesiid, Amorphid and Sphingid larvæ. According to Poulton (*loc. cit.*, 1885, p. 302) the coloured borders to the oblique and other lines in Sphingid larvæ seem always to be formed of modified ground-colour. He states that "dots are either absent from the borders, or, when present, are very small," and surmises that "the first trace of a border arose in the diminishing size of the dots, which alone would make a relatively dark stripe . . . . the effect afterwards being increased by a darkening of the ground-colour, and, in some instances (*e.g.*, *Sphinx ligustri)*, by a change of colour altogether." It may be well to notice here the great similarity between the markings and general appearance

of *Sphinx ligustri* and the green (yellow) form of the larva of *Manduca atropos*, and Weismann's observation (*Studies in Theory of Descent*, transl. p. 145) that the violet bands of the latter correspond with the coloured borders of the stripes of the former, and not with the stripes themselves, these, in *M. atropos*, having become inconspicuous. As a summary of the development of the oblique stripes of Sphingid larvæ, and their borders, Poulton gives (*loc. cit.*, 1886, p. 148) the following:

1. A hairy* larva with greenish or yellowish ground colour, the hairs springing from light (white or yellow) tubercles.
2. The hairs become inconspicuous, and the tubercles more distinct.
3. The tubercles become especially enlarged and approximated along the lines of the oblique stripes, thus forming the first indication of this system of marking.
4. The light colour spreads from the base of each tubercle, and the adjacent areas coalesce, forming a continuous stripe.
5. The tubercles disappear from the ground-colour along the anterior edge of each stripe, thus producing a relatively dark border.
6. The border is rendered more distinct by a deepening in the tint of the ground colour.
7. The border becomes a conspicuous feature in the oblique line system, gaining a distinct and generally bright tint, a modification or replacement of the ground-colour.
8. The original oblique stripes fade away until they are hardly recognisable, while the bright borders become highly developed, and almost entirely represent the whole system.

Poulton remarks (*loc. cit.*, p. 149) that "this history may be traced up to the end of the 7th stage in the ontogeny of *Sphinx ligustri*, up to the end of the 6th in *Smerinthus ocellata*, whilst the larva of *Manduca atropos* supplies the 8th stage," and he adds that, although these stages occur successively, it must not be overlooked, as Weismann had long before pointed out, that certain stages of the ontogeny may be dropped, *e.g.*, the 7th may follow the 4th in some species, and so on.

Chapman observes that among the imaginal characters of the *Sphingides* is one that occurs elsewhere, but nowhere else, so far as he has ascertained, affects the whole superfamily, or even a whole subfamily. This is the curious development along the posterior margins of the abdominal segments of a row (or rows) of scales, modified into fusiform batons, with sharp points, usually of a black colour, at any rate very rarely not darker than the general abdominal scaling. In some cases, these are very solid strong black structures with little evidence as to their being modified scales, in others they present definite traces of striation, not dissimilar from ordinary scales. When removed they leave, on the chitinous plate, a row of pits, almost identical with those from which the scales beside them have been removed, but of very much larger size. In a few Sphinges, these batons are developed into a row of strong spines, solidly and stiffly attached to the margin of the segment, sharp and long enough to prick the fingers if properly applied (*Pseudosphinx tetrio*, &c.). In others they are very numerous in three or four rows but rather shorter and weaker than the scales around them (*Hyloicus pinastri*). They are well developed in *Sesia* and in the

* "Hairy" must be understood as referring to the hairs in the 1st larval instar of Amorphids, so that Poulton's 1st stage is the 1st in Amorphids, but 2nd in Sphingids (*sens. restr.*). The shagreening proper does not even occur in the 1st instar of Amorphids, for, although the hairs are present, they cannot be properly termed shagreened as neither mammillæ nor pigment-spots are present, so that there would appear to be a stage with secondary hairs preceding Poulton's stage 1, *i.e.*, with secondary hairs not springing from light-coloured mammillæ (Bacot).

Phryxids. In the Amorphid imago, they are especially weak, and, at first sight, appear to be wanting, but, in reality, they are scattered over the whole dorsum of the segment and are but little more numerous along the hind margin, and they have scale-cups for attachment, about twice the size of those of the ordinary scales (*Amorpha populi*). In *Mimas tiliae* they also exist over the whole segment but are here very little differentiated from scales, differing chiefly in being narrow and overloaded with pigment and often with bifid extremities, and it would almost be more correct to say that they are wanting, but that the scales are somewhat modified. They are frequent also in Noctuids. In the Geometrid, *Nyssia hispidaria*, they are developed in two forms, one of which occurs all over the dorsum. Treating this as a structure characteristic of the *Sphingides*, as being found in the whole superfamily, and highly developed in many genera and families, it would seem to add another to the many characters otherwise noted, that show the Amorphid imago (and pupa) to be the most primitive in the group, although the larval specialisation has made more advancement than in the other families, perhaps actually, but certainly in having the earliest stages more modified by the effects of later features passed back to the first instar than in Eumorphids or even Sphingids *(sens. restr.)*.

We know of no real attempt since Hübner's time *(anteà*, vol. iii., pp. 351-352) to classify the species included in the *Sphinginae*, and most authors seem to have surmounted the difficulty by placing as many heterogeneous species as possible in the same genus, whilst our British authors, *e.g.*, Stainton, Meyrick, &c., have dealt with the matter in the simplest possible manner, *viz.*, by placing them all in the same genus and neglecting altogether any detailed consideration of the structure of the species. The most recent German work (Bartel, *Pal. Gross-Schmett.*, ii., p. 37) deals with the group in the same manner, and Bartel writes: "In Europe, *Sphinx* is only represented by 3 species, of which *S. convolvuli* is very widely distributed, *S. ligustri* occurs also in Siberia and Japan, and only *S. pinastri* is confined to Europe proper." He then adds: "The genus is very numerous in the tropics. Herrich-Schäffer united the genera *Sphinx* and *Deilephila*, but *Deilephila* is distinguished, not only by its different larvæ, and more especially by its pupæ, but also by the neuration, nervure 8 of the forewings running into the apex, while this nervure in *Sphinx* runs into the outer margin just below the apex (!). Later systematists have rightly separated the genera* again." He then gives the following "table of the Palæarctic species" that he includes in *Sphinx*:

I. Abdomen with red spots on the sides. Hindwings with black transverse bands.
  1. Fringes chequered; hindwings blue-grey—*convolvuli*, L.
  2. Fringes unicolorous; hindwiugs light rose-colour—*ligustri*, L.

II. Abdomen with black spots on the sides. Hiudwings without dark bands.
  1. Hindwings unicolorous—*pinastri*, L.
  2. Hindwings before the inner angle with a white longitudinal ray, followed by a short, uninterrupted light transverse stripe—*increta*, Walk.

We would now refer our readers to Hübner's grouping of the true Sphingids *(anteà*, iii., pp. 351-352), which he included in his

* Bartel treats the whole of our *Sphinginae* as one genus and the *Eumorphinae* as another.

stirps Manducæ, and it appears to us remarkable that he was able, at so early a date and with so little material, to arrive at detailed conclusions regarding their relationship much more accurate than any author who has since written on the subject. This is particularly the case in his treatment of the Erinnyids [*i.e.*, the Pseudosphingids (*Pseudosphinx tetrio*) and Dilophonotids (*Erinnyis ello*)], the former of which has always been placed with the true Sphingids, near *Hyloicus*, by authors who have followed him, but this view is open to great doubt, considering the larva of *Pseudosphinx tetrio* and the general imaginal structure. It is remarkable that the peculiar double thoracic tuft of *Erinnyis (ello)* and the crenate hindmargin of the wings are repeated in *Pseudosphinx (tetrio)*, and one concludes that the Pseudosphingids include the Dilophonotids or *vice versâ*. The Erinnyids (*Pseudosphinx, Isognathus, Cautethia, Dilophonota, Anceryx, Grammodia (caicus)*, &c.) also have the ocellar tufts of the metathorax developed differently from those of the Sphingids (*sens. restr.*). It is to be observed, as we have just said, that the Pseudosphingids have, since Hübner's time, always been placed among the true Sphinges, but, whilst it is true that the general appearance of the imago, particularly the abdomen thereof, is very Sphingid, it has also to be remembered that the larva is peculiarly Eumorphid in most characters, and that the pupa is without a tongue-horn and has a general Philampelid or almost Eumorphid structure. It is probable, therefore, that these Sphingids should be grouped outside the true *Sphinginae*, as, indeed, was substantially done by Hübner so long ago. It is impossible, with the space at our disposal, to enter into a consideration of the relationships of the various tribes in the subfamily, but the following summary represents the conclusions at which we have arrived, and gives the names of what we consider to be the chief Sphingine (*sens. restr.*) tribes, of which the first two are the most generalised, the 1st leaning to the Amorphids, the 2nd to the Sphingids (*sens. restr.*). These tribes are—

1. Kentrochrysalidi *—*Kentrochrysalis streckeri.*
2. Ceratomiidi †—*Ceratomia amyntor, Daremma undulosa, D. catalpae.*
3. Dolbidi—*Dolba hylaeus.*
4. Hyloicidi—*Hyloicus pinastri, ? Meganoton casuarinae.*
5. Sphingidi—*Sphinx ligustri, S drupiferarum, S. kalmiae, &c.*
6. Agriidi ‡—*Agrius convolvuli, A cingulata.*
7. Phlegethontiidi—*Phlegethontius rustica, carolina, celeus, Coelonia fulvinotata.*
8. Cocytiidi (Amphonygidi) §—*Cocytius (Amphonyx) antaeus (medor), duponcheli, cluentius.*
9. Euryglottidi—*Euryglottis aper.*
10. Manducidi—*Manduca atropos.*

It will be observed that the four British species referable to the *Sphinginae* fall into four of the different tribes into which the species of the subfamily may thus be grouped, *viz.*—(1) Hyloicidi—*Hyloicus (pinastri)*. (2) Sphingidi—*Sphinx (ligustri)*. (3) Agriidi—*Agrius (convolvuli)*. (4) Manducidi—*Manduca (atropos)*.

Tribe: Hyloicidi.

The Hyloicids are, so far as the pupal and imaginal characters

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* Rather Amorphid, pupal dehiscence also Amorphid.

† Generalised form, pupa with eyes facing ventral, and labrum ventral.

‡ Highly specialised labial palpi, which differ markedly from those of Phlegethontiids.

§ Imagines with tendency to clear hindwings.

are concerned, possibly rather more generalised than the Sphingids (*sens. restr.*), as represented by *Sphinx ligustri*, but the larva of *Hyloicus* is exceedingly specialised to its foodplant and appears, in the more typical species (*pinastri*), to have entirely lost all traces of the characteristic oblique stripes, and to have developed an entirely new ornamentation to respond to the peculiar environment engendered by the pine-trees on which the larvæ of many of the species live. The pupa of the genus *Hyloicus*, as represented by *pinastri*, has a tongue-horn, developed to about the extent of that in *Sphinx* (*ligustri*); this becomes a marked feature in *Agrius* (*convolvuli*), and assumes a projecting curved form in the higher Phlegethontiids and Cocytiids (Amphonygids). Although, in this particular, *Hyloicus* would appear to be a low form, one cannot say that it is higher or lower than *Sphinx*, yet one is inclined to place the latter lower than *Agrius*, chiefly, perhaps, on the ground that, where one has nothing better to go on, the development of the maxillæ appears to be some measure of the advance made. *Sphinx* is nearer *Ceratomia*, a low form, inasmuch as the pupa of the latter has a ventral labrum and no tongue-horn; *Hyloicus* is not far from the same level as *Sphinx*, but its larval specialisation makes it different but not necessarily higher or lower, although its line of specialisation runs away from what we have learned to consider the normal form of Sphingid (*sens. restr.*) larva. The Hyloicid larvæ that feed on pine have, as we have already said, become so specialised in their markings and coloration to agree with their environment that they have lost the characteristic oblique stripes that the Sphingid (*sens. restr.*), in common with the Amorphid, larvæ possess, and look very unlike, in the larval stage, the species to which the pupal and imaginal structures show them to be most closely allied. Of the Hyloicid larvæ, Weismann notes that *coniferarum*, a North American species living on *Pinus palustris* and figured by Abbot and Smith, has the colour and markings very similar to those of *H. pinastri*, whilst, on the other hand, the larva of *Dilophonota (Erinnyis) ello*, which, by-the-bye, is not a Hyloicid but a Pseudosphingid, he says, is described by Clemens as dark brown with a white dorsal line and irregular white spots on the sides, and lives on a species of *Psidium* or *Guava*. Kirby says (*Handbook*, &c., iv., p. 49) that there are several American genera allied to *Hyloicus*, including species measuring two or three inches across the wings, in which the hindwings are red or yellow, with black or brown borders, and instances *Dilophonota* (*ello*, *oenotrus*, *melancholica*), *Phryxus** (*caicus*), *Anceryx* (*alope*, *fasciata*, *edwardsii*) (see Kirby, *Cat.*, pp. 696-699), all of which are Erinnyids and have no real Hyloicid relationship.

Genus: Hyloicus, Hübner.

Synonymy.—Genus: *Hyloicus*, Hb., "Verz.," p. 139 (*circ.* 1822); Stephs., "Illus. Haust.," iv., app. p. 5 (1835); "List Br. An. Br. Mus.," p. 27 (1850); Grote, "Proc. Ent. Soc. Phil.," v., p. 190 (1865); Butl., "Trans. Zool. Soc. Lond.," ix., pt. 10, p. 616 (1876); Kirby, "Cat.," p. 693 (1892); "Handbook," &c., iv., p. 49 (1897); Leech, "Trans. Ent. Soc. Lond.," p. 287 (1898); Staud., "Cat.," ed. 3, p. 101 (1901). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 492 (1758); xiith ed., p. 802 (1767); "Faun. Snec.," 2nd ed., p. 288 (1761);

* Erroneously applied here by Kirby; *livornica* is the type of *Phryxus*, see *anteà*, p. 146. For this genus (with *caicus* as the type) Jordan has proposed the name *Grammodia*.

Poda, "Ins. Mus. Græc.," p. 80 (1761); Scop., "Ent. Carn.," p. 187 (1763); Hufn., "Berl. Mag.," ii., p. 182 (1766); Drury, "Ill. Exot. Ent.," pl. xxvii., fig. 2 (1773); Fab., "Syst. Ent.," p 541 (1775); "Spec. Ins.," ii., p. 146 (1781); "Mant.," ii., p. 95 (1787); "Ent. Syst.," iii., pt. 1, p. 367 (1793); [Schiff.,] "Schmett. Wien.," p. 41 (1775); Ill.'s n. Ausg., p. 10 (1801); Esp., "Schmett. Eur.," ii., p. 106, pl. xii., figs. 1—3 (1779); p. 233, pl. xxxvi., fig. 9 (1786); Bergstr., "Sphing. Larv.," p. 6 (1782); Retz., "Gen. et Spec. Ins.," p. 33 (1783); Bork., "Sys. Besch.," ii., pp. 101, 147, 180 (1789); Brahm, "Ins.-Kal.," ii., p. 127 (1791); Hb., "Eur. Schmett.," ii., fig. 67 (1796); text, ii., p. 98 (*circ.* 1805); "Larvæ Lep.," ii., Sph. iii., Legit. C, a, figs. 1 *a—d* (*circ.* 1800); Schrank, "Faun. Boica," ii., 1, p. 224 (1801); Don., "Brit. Ins.," ix., p. 19, pl. 296 (1800-1); Haw., "Lep. Brit.," pt. 1, p. 59 (1803); Ochs., "Die Schmett.," ii., p. 243 (1808); iv., pp. 43-44 (1816); Leach, "Edinb. Encycl.," ix., p. 131 (1815); Dalm., "Vet. Ak. Handl.," xxxvii., p. 214 (1816); Sam., "Ent. Comp.," p. 244 (1819); Godt., "Hist. Nat.," iii., p. 30 (1822); Stphs., "Ill. Haust.," i., p. 121 (1828); "Cat. Br. Ins.," ii., p. 32 (1829); Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); "Gen. et Ind. Meth.," p. 48 (1840); "Hist. Nat. Sphing.," p. 104 (1875); Meig., "Eur. Schmett.," ii., p. 145 (1830); Dup., "Hist. Nat.," supp. ii., p. 157 (1835); Dunc., "Brit. Moths," p. 144 (1836); Wood, "Ind. Ent.," fig. 13 (1839); Zett., "Ins. Lapp.," p. 916 (1840); Dup., "Icon. Chen.," pl. ii., fig. 2 (*circ.* 1835); "Cat. Méth.," p. 41 (1844); Ratz., "Forst-Insecten," ii., pp. 74-76 (1840); Humph. & Westd., "Br. Moths," i., p. 14 (? 1841); Evers., "Faun. Volg.-Ural.," p. 112 (1844); H.-Sch., "Sys. Bearb.," ii., p. 90 (1846); Dbldy., "List Brit. Lep.," p. 3 (1847); Heydrch., "Lep. Eur. Cat. Meth.," ed. 3, p. 18 (1851); Sta., "Man.," i., p. 90 (1857); Speyer, "Geog. Verb. Schmett.," i., p. 321 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.," i., p. 148 (1859); Humph., "Gen. Brit. Moths," p. 9 (1860); Staud., "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 36 (1871); Wallgrn., "Skand. Het.," i., p. 34 (1863); Snell., "De Vlind.," p. 98 (1867); Berce, "Faun. Franç.," ii., p. 13 (1868); Nolck., "Lep. Fn. Estl.," i., p. 87 (1868); Mill., "Cat. Lép. Alp.-Mar.," p. 117 (1872); Bang-Haas, "Nat. Tids.," (3), ix., p. 402 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 39 (1874); Curò, "Bull. Soc. Ent. Ital.," vii., p. 110 (1875); Kirby, "Eur. Butts. and Moths," p. 68, pl. xvii., fig. 1 *a - b* (1879); Frey, "Lep. Schweiz," p. 56 (1880); Buckl., "Larvæ," &c., ii., pp. 27, 112, pl. xxii., fig. 3 (1887); Auriv., "Nord. Fjär.," p. 45 (1889); Meyr., "Handbook," &c, p. 298 (1895); Lucas, "Brit. Hawk-Moths," p. 80 (1895); Barr., "Lep. Brit.," ii., p. 27, pl. xlvi (1895); Thell., "Ent. Rec.," vii., p. 131 (1895); Tutt, loc. cit., p. 132 (1895); "Brit. Moths," p. 27 (1896); Camb., "Ent. Rec.," vii., p. 218 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 48 (1899). *Herse*, Oken, "Lehrb. Zool.," i., p. 762 (1815). *Anceryx*, Walk., "List," &c., viii., p. 223 (1856); Kirby, "Ent. Mo. Mag.," i., p. 254 (1865); Weismann, "Studies," &c., transl. p. 265 (1882); Leech, "Proc. Zool. Soc. Lond.," 1888, p. 588 (1888). *Atreus*, Grote, "Hawk-Moths N. America," p. 41 (1886).

The genus *Hyloicus* was diagnosed (*Verz.*, p. 139) by Hübner as follows:

> All the species whitish-grey, black marked, the forewings with straight and waved stripes; the hindwings shaded with blackish—*Hyloicus pinastri*, Linn., *H. coniferarum*, Abb., *H. menephron*, Cram., *H. pamphilius*, Cram., *H. hylaeus*, Cram., *H. hasdrubal*, Cram.

Hübner's genus is, of course, heterotypical, and, in its broad lines, is clearly intended to include the Pseudosphingids, to which *H. pinastri* is here referred; however, in 1835, Stephens placed (*Illus.*, iv., app. p. 5) *pinastri* as the British exponent of Hübner's genus *Hyloicus*, and again, in 1850, in his *List of the Specimens of British Animals in the Collection of the British Museum*, pt. v, he follows this synonymy, and Grote, Butler, and other authors have since adopted this view. Weismann fully supports the separation of *Hyloicus* from the other Sphingine groups (*Studies in the Theory of Descent*, transl. p. 264), stating that the separation of this genus from *Sphinx* appears to be justified, not because of the striking differences presented by the

moths, but because the caterpillars, judging from the little we know of them, likewise show a similar degree of difference. The genus is diagnosed by Kaye *(in litt.)* as follows :

Forewing long and narrow, the costa almost straight in ♂ to above the origin of nervure 7 and then flatly curved to apex ; in ♀ the costa is straight only for a very short distance from base, and is curved for the greater part of its length; the outer margin very flatly curved, the inner margin almost straight, the angle at tornus about 175°. Hindwing with costa well arched, apex moderately pointed, outer margin flatly curved to nervure 1*b*, where it is slightly excised ; nervure 8 receding from cell near base and then approaching closely to 7 to near apex, wheu it sharply recedes to costa ; cross nervure between 7 and 8 weak, and given off at less than half length of cell, nervures 6, 7 shortly stalked. Head moderately large. Legs moderately long, rather slender, spurs on hind tibia very long, the lower pair longer and stouter than the upper. Exclusive of the femur, the three pairs of legs are more uniform in length than is usual, caused by the 1st pair being unusually long. Abdomen long and very pointed in the ♂, rather blunt in ♀— *Hyloicus pinastri* (type of genus).

Kirby notes (*Handbook, &c.*, iv., p. 49) that "*Hyloicus* includes a number of moderate-sized and rather dull-coloured species found in various parts of the world. The wings are shorter and less pointed than in *Sphinx*, and the forewings are broader towards the base. The larva is provided with a horn, but much more slender than *Sphinx*, and is marked with continuous longitudinal lines, instead of oblique lateral stripes." Kirby's genus *Hyloicus* (*Cat.*, p. 693) is, of course, hopelessly heterotypical.

Hyloicus pinastri, Linné.

Synonymy.—Species : *Pinastri*, Linn., "Sys. Nat.," xth ed., p. 492 (1758); xiith ed., p. 802 (1767); "Faun. Suec.," ii., p. 287 (1761), &c. [Note.—This species has not been known by any other specific name* from the time of Linné. All the references made under the generic synonymy of *Hyloicus*, Hb., *anteà*, pp. 274-275, are referable here.]

Original description.—*Sphinx pinastri*, alis integris canis margine postico albo maculato, abdomine fusco annulis albis. Gadd., *Diss.*, 28. *Phalaena* fusco-cinerea subulicornis, thorace hirsuto griseo, lineis duabus nigris longitudinalibus. Reaum., *Ins.*, i., t. 13, f. 8. De Geer, *Ins.*, i., t. 10, f. 1, 2, 3. Roes., *Ins.*, i., phal. 1, t. 6. Habitat in Pino. Alæ superiores in medio lineolis 3 nigris inæqualibus notatæ (Linné, *Sys. Nat.*, xth ed., p. 492).

Imago.—70mm.-100mm. Anterior wings slaty-grey, sprinkled with paler scales ; two irregular transverse grey-brown bands, one just before the other just beyond the middle, sometimes uniting beneath the tiny white discoidal spot ; the outer band contains three longitudinal blackish-brown lineolæ just below the discoidal ; there is an oblique blackish-brown apical streak ; fringes chequered white and dark brown-grey. Posterior wings blackish-grey, paler at base ; fringes chequered white and dark brown-grey.

Sexual dimorphism.—I am not prepared to give any measure of the differences in size, colour, build, &c., in the sexes, though they appear to be in favour of the ♀ being decidedly larger, &c., as in other Sphinges. The antennæ are longer in the ♂, as 13·5mm.

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* Some authors refer *asiaticus*, Btl., and *saniptri*, Strecker, as synonyms to this species, and, unless they be treated as aberrations, this must be done, as it is quite clear from the descriptions and types that these authors failed entirely to recognise forms of the species agreeing almost exactly with many ceutral European examples.

to 11mm., with some variation, as 14mm. to 11·5mm. The joints are about 63 in number in both sexes; the ♂ antenna is very slightly thicker, that of the ♀ is more slender towards the base, giving (very slightly) a clubbed appearance. The hair-pockets of the ♂ antennæ are very completely and regularly developed, each like the next, the same on distal and proximal sides, close up to the ventral carina, &c. Though the rows of scales are exceedingly irregular, the scaling is readily recognised as disposed in three rows to a segment, that on the ♂ being a little the more irregular. The front tibiæ are of about equal size in the two sexes, but the ♂ spur is about 2·2mm. long, that of the ♀ only 1·8mm.; the comb on the ♂ spur occupies about 1.2mm. of its length, it is proportionally slightly shorter in the female, *viz.*, 0·9mm. The scent-fan of the ♂ arises from a narrow area about 0·9mm. long, on a narrow chitinous slip, apparently in the centre of the membrane between the dorsal and ventral plates of the 2nd (apparently 1st) abdominal segment; really, however, this slip is part of the ventral plate, being connected in front with the anterior corner of the plate. The hairs are about 3·8mm. long and lie in a pocket (when at rest) in this and the following segment. On the following segment, similarly situated, is a long narrow hair-bearing area (1·3mm. long), that has all the appearance of being a fan like the primary one, the hairs are, however, comparatively short and differ little from those on the general surface. The marginal batons in this species are in several closely packed rows (Chapman).

Variation.—There is a very wide range of variation in this species, and the British Museum coll. (thanks to the addition of the "Leech coll." specimens) contains a magnificent series of aberrations. The pale greyish-white or hoary form with three blackish longitudinal lineolæ is the type, but a magnificent pale specimen, with greyish-white forewings and deep brown characteristic lineolæ, and, in addition, a dark median band, divided only in its upper half, and labelled "Leech coll., Berlin,"* is exceedingly fine, whilst a second European example of almost exactly the same form, shows the brown shading of the centre of the forewings even more markedly developed into single banded form (=ab. *typica-virgata*, n. ab.); the aberration in which the dark transverse markings take the form of two dentate transverse lines, and with the three characteristic lineolæ absent, forms the ab. *fasciata* of Lampa. The more common central European form is of slaty-grey hue, and assumes seven principal aberrations: (1) Uniformly grey, except for the three typical dark lineolæ, and with merely the barest trace of the usual darker shading at the base of the inner margin and on the costa (=ab. *asiaticus*, Btl.). (2) Uniformly grey, without the dark lineolæ or transverse shades (=ab. *grisea*, n. ab.). (3) Uniformly grey, without the lineolæ, but with the transverse shades (= ab. *grisea-transversa*, n. ab.). (4) Uniformly grey, without darker shadings, but with a white median spot (=ab. *grisea-mediopuncta*, n. ab.). (5) Uniformly grey, without lineolæ and with the transverse shades united practically throughout into a single median brown fascia (=ab. *virgata*, n. ab.).

* It may be advisable to note that Leech bought the "Mützell collection" of lepidoptera, and that the specimens which were found therein are now labelled "Berlin." Although Mützell lived at Berlin, it is quite possible that many of his insects were not captured in the Berlin district.

(6) Grey with well-developed lineolæ and transverse markings (=ab. *grisea-distincta*, n. ab.). (7) With the darker brown shading spread uniformly over all the wings, producing a dark brown unicolorous melanochroic form (=ab. *unicolor*, n. ab.). The single American example in the Brit. Mus. collection, labelled "United States," is a very typical example of the grey form, with three distinct lineolæ and indistinct shades, being very close indeed to Strecker's type figure of *saniptri* (*Lep. Rhop. and Het.*, pl. xiii., fig. 18), although one of the usual lineolæ is very poorly developed in the latter. Butler's var. *caligineus*, on the other hand, is an exceedingly distinct and well-specialised race of rather small size, of deep grey coloration, often with a slight coppery tinge, tending to uniformity of appearance, and with the transverse shades developed rather as two faint elbowed lines, one before and one just beyond the middle of the wing; the central white discoidal spot, apparently rare in European examples, is almost always more or less developed. With regard to albinistic tendencies, Schultz writes (*Ill. Woch. für Ent.*, ii., p. 706) that he has a ♀ with the apex of both forewings albinistic, also a ♂ with the hindwings partially affected in a similar manner. There is remarkable variation in the coloration of the thorax and abdomen, largely following, however, the tint of the forewings; in some, especially the eastern examples (var. *caligineus*), these are practically unicolorous, in others, the thorax is strongly marked longitudinally with dark, and the abdomen takes on a banded form of brown-grey and white almost as marked as bands, as are those of *Sphinx ligustri*. The only forms that have been described appear to be as follows:

α. ab. *fasciata*, Lampa, "Ent. Tids.," vi., p. 26 (1885); Kirby, "Cat.," p. 693 (1892).—Med tvänne mörka, tandade tvärstreck i stället för de tre svarta fläckarne på framvingarne. Se Thedenius, *Ent. Tids.*, 1880, p. 197.—Sverige, Ostergötland [Kindberg] (Lampa); Färlöf, near Kristianstad (Anderson).

Lampa gives the name *fasciata* to that form in which there are two, dark, dentate, transverse lines in place of the three black spots on the forewings.

β. ab. *asiaticus*, Butl., "Proc. Zool. Soc. Lond.," 1875, p. 260 (1875); Kirby, "Cat.," p. 693 (1892).—Nearly allied to *H. pinastri*, larger, darker, outer margin of primaries straighter, the spot in cell perpendicular, the median streaks longer, the central nebulous fascia less defined; body dark grey; pterygodes almost entirely chocolate-brown; abdomen with lateral black spots smaller, less defined; wings below paler; the transverse discal brown streak scarcely visible in primaries, and further from outer margin; ventral blackish spots larger. Expanse 3in. 7lin. "Probably from Scinde"! [Warwick] (Butler).

This specimen, now in the Brit. Mus. coll., has the facies of the European and American examples and is very dissimilar from the Japanese form, the only Asiatic one known to us. In fact, it is of exactly the same type as the United States example in the Brit. Mus. coll., *i.e.*, grey, with the three lineolæ well-marked and the transverse shades practically obsolete. Hampson states (*Ind. Moths*, i., p. 123) that, in his opinion, the specimen was not taken in India, and that the "Scinde" label on Butler's type is almost certainly an error.

γ. ab. *saniptri*, Strecker, "Lep. Rhop. Het.," p. 118, pl. xiii., fig. 18 (1876); Kirby, "Cat.," p. 693 (1892).—♂. Expands 3ins. Uppersurface in colour and ornamentation the same as in the European *S. pinastri*, L., with this exception, that the latter has two broad transverse brown bands on primaries, the outermost of which is entirely wanting in the present insect, and the inner-

most is quite narrow and darker in colour than in *S. pinastri* *. Undersurface uniform brownish-grey, faint traces of a mesial band on secondaries. In *S. pinastri* the marginal part of primaries is a little paler and more ashen than the rest of the wing; in this species there is no perceptible change in the coloration. ♀. Expands 3¾ins. Head and body same as ♂. Uppersurface of primaries same colour as ♂, destitute of all markings save a faint apical line and the obscure streaks in cells between the median nervules near the median nervure. Undersurface uniform dull greyish-brown. Described from one ♂ and one ♀. The former was captured in Canada and was received by me from Mr. Reakirt; the ♀ I took sitting on a fence, near some pine woods a mile from Reading, Pa. I have never seen any others. Both examples are in good condition, though the ♀ is a little worn, they seem to me to be an intermediate form between *sequoiae* and *pinastri*, though very close to the latter (Strecker).

Strecker adds that he knows not if this species be a form of *H. pinastri*, as he has "never seen an example of the latter destitute of the broad brown transverse shades of the primaries; but should this be the case, it is an easy matter to re-anagramize the name back to its original spelling, und alles ist wieder gut." He further adds some rough descriptive notes of two larvæ that he considers belonged to this species. These read: "Not quite three inches long, rather slender, head yellow, striped with red; body reddish, surrounded with many transverse fine black lines; a brown stripe on back from head to anal horn, this stripe lined with white on both sides; on the sides alternate bands or lines of green and yellow, green predominating from head to last segment (save one); caudal horn dark reddish-brown; the first few spiracles white, the others ringed with red and black; from base of anal horn to end of anal segment, a reddish brown dorsal line. Found in October, crawling on the ground, among the dead pine leaves in the same piece of wood as the above ♀ was captured." In our opinion, Strecker's figure and the United States example in the British Museum collection are, without doubt, referable to the grey form of *H. pinastri* with well-developed lineolæ and ill-developed transverse shades. What is more remarkable is that it is exactly the same form as Butler's *asiaticus*, with the exception that only two of the three normal longitudinal lineolæ of the forewings are developed in *saniptri*.

ζ. var. (an spec. dist.) *caligineus*, Butl., "Ann. Mag. Nat. Hist.," (4), xx., p. 393 (1877); "Ill. Lep. Het.," ii., p. 2, pl. xxi., fig. 6 (1878); Staud., "Cat.," 3rd ed., p. 101 (1901). *Pinastri*, Leech, "Proc. Zool. Soc. Lond.," p. 588 (1888); "Trans. Ent. Soc. Lond.," 1898, p. 287 (1898). *Caliginosus*, Kirby, "Cat.," p. 613 (1892).—Allied to *H. pinastri*, but differing in its dark smoky-grey colouring, the white markings on the body and the lateral black spots on the abdomen wanting, the transverse bands on the primaries and the secondaries smoky-brown, the two longitudinal black dashes on the primaries shorter and more linear. Expanse of ♂ 2in. 8lin., ♀ 3in. 2lin. Yokohama [Jonas] (Butler).

Staudinger diagnoses this form (*Cat.*, 3rd ed., p. 101) as "abdomine fere non maculato." Leech unites [*Proc. Zool. Soc. Lond.*, p. 588 (1888)] Butler's *caligineus* with *pinastri*, observing: "In his identification of the dark Japanese form of this species, Butler refers to the absence of 'white markings on the body,' and 'lateral black spots on the abdomen'; in my series of *H. pinastri* from Japan I find that almost every specimen has the body paler where the white markings should be, and dark patches along the sides are distinctly

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* In a specimen in the British Museum collection labelled "United States" both these transverse shades are indicated, so that the absence of these bands cannot be considered as characteristic of American examples.

visible. The dark form is most frequent in Japan, but in Pryer's collection there is one example of *H. pinastri* which has a pale grey ground colour, clouded with darker, and with strong and sharply defined markings. This is one of three examples labelled no. 16, and noted as occurring, newly emerged, on stems of yew-trees. . . . Distribution, Yokohama (Jonas and Pryer); Nagahama, Tsuruga, Fushiki, Ningpo (Leech)." Fletcher writes *(in litt.)*: "I have only once met with this species, August 6th, 1898, when I got a fine specimen at rest on a fir-tree on the Bluff at Yokohama. It was seven or eight feet from the ground on the north side of the tree." We cannot altogether understand Leech's remarks above. At the present time Pryer's and Leech's examples are all in the British Museum collection. Not only is the ground colour of the eastern (Japanese and Chinese) race characteristically different from all other forms represented, but the coppery tint in the dark ground colour of the wings, the dark, almost unicolorous, thorax and abdomen, the ill-developed markings and smaller size give this race a most marked facies. The palest of Pryer's examples in no way approaches the European form. We may point out that the *caligineus* form exhibits, *inter se*, much aberrational variation: thus we have: (1) Unicolorous grey, with two faint coppery-tinged transverse lines. (2) As in 1, but with white median discal spots. (3) Unicolorous grey, with slight coppery tinge, with the three typical lineolæ. (4) As in 3, but also with indistinct transverse shades. (5) Unicolorous grey, with the three typical lineolæ, and with distinct transverse shades. The examples now in the British Museum collection came from Tokei, Fushiki, Nagahama, Kiushiu, Ningpo and Tsuruga.

EGGLAYING.—The eggs are laid singly on the needles of the pine in June and July (Roesel), but, although this may be so generally, sometimes little groups of from two to a dozen are laid together, the ♀ resting for oviposition and not performing the operation on the wing, the eggs being laid almost as soon as copulation is completed (Head), and Werneburg also notes that the eggs are laid irregularly in small groups of from 10-15 on the sides of the pine-needles, mostly at the top of the stems. Hartig records that the egg stage generally lasts from 10-14 days. Head forwarded us some eggs that had been deposited in confinement on July 6th, and these hatched July 18th-19th, 1901; Oldaker records ova that hatched July 13th, 1901, whilst Buckler received some from Heyne of Leipzig on July 26th, 1882, that hatched between July 29th and August 2nd.

OVUM.—Rather over 2mm. in length and 1·75mm. in width. In outline an almost perfect oval, the micropylar end being slightly broader and rounder than the opposite end. The surface is almost smooth, with a faint reticulation developing into a more marked, but still superficial, irregular polygonal network towards the micropylar end, the cells or areas becoming very distinctly defined the nearer one approaches the micropyle; they are also fairly well-developed at its nadir. On the upper-surface, towards the micropylar end, a small somewhat shallow depression of oval or circular outline. Colour bright green, distinctly brown towards the micropylar end (apparently the head of developing larva), this brown area being yellowish,

then buff before becoming brown; tint yellowish-green towards its nadir. The contents also give rise to longitudinal yellow bands, again evidently the embryo. The micropylar area itself is slightly depressed. There is considerable variation in size, some of the eggs having apparently not more than $\frac{3}{4}$ the cubical contents of others. The eggs are evidently attached, those described having been separated from the surface on which they were laid (Tutt. Described July 10th. 1901, from ova received from Mr. Head, and laid July 6th). The eggs are as large as those of *Smerinthus populi*, but not so round, the shape being roundish ovate; the surface smooth and glossy, and their colour, when received, of a light greenish-ochreous-yellow, or pale olive-yellow; some were clouded within with brown, in some instances with quite dark brown at the end; the shell had a pearly lustre. Before hatching, the dark lobes of the embryonic head were distinctly visible at one end (Buckler). Yellowish, shining, oval, of the size of millet seed (Roesel). The eggs are figured by Ratzeburg (*Forst-Insecten*, ii., pl. ii., fig. 3*e*).

Habits of larva.—The newly-hatched larva is quite unlike that of any young Sphingid larva that I have previously seen both in general appearance and behaviour. It is short, stout, active and restless in crawling, curves its body and has a writhing or wriggling manner that is quite foreign to the usual method of crawling adopted by young Sphingid larvæ; it appears also to be less stiff and more flaccid than other Sphingid larvæ (Bacot). The young larvæ, when first hatched, eat along the side of the needle-like leaves of *Pinus*, but, after the second moult, they attack it from the end and bite it quite through, thus continuing to eat as they gradually step backwards and as the needle becomes shortened, until the leaf is consumed close up to the sheath at the twig or stem. Just before entering the earth, the larvæ cover their skins all over with some fluid discharged from their mouths (Poulton makes a similar observation about the larva of *Sesia stellatarum*) [Buckler]; Thellusson observes (*Ent. Rec.*, vii., p. 132): The first and last moults appear to be the most dangerous periods for the larvæ, otherwise they seem to be fairly easy to rear; feeding them on too green and succulent food, also, produces diarrhœa and the larvæ turn almost to water. They feed exclusively on the pine, beginning on the top of the firs and eating downwards to the stalk, and, in confinement, they appear to eat by night and day. The young larvæ are stated by Ratzeburg to spin silk for a holding surface, and he adds that the habit is continued even after the second moult; he also observes that, when quite young, they merely nibble the needles, but later eat them right off. Nickerl says that, in 1827, the larvæ appeared at Brandreis, in such numbers that, in certain firwoods, the trees were completely stripped, and that the pupæ were so abundant in the autumn that they were used for feeding swine. Alderson notes (*in litt.*) that the larvæ imitate excellently the needles and twigs of fir; he observes that, as the larvæ commence eating from the top of a needle and continue downwards, the green colour of the young larvæ matches well the tint of the needles, whilst, as they become larger they match the twig, *i.e.*, the bark whence the needles spring, so that, by the time they clear off the needles from a branch, they are difficult to see because they match the bark so closely. Bartel notes (*Pal. Gross-Schmett.*, ii., p. 49)

that the larva lives from June to October on conifers, to which it is often very injurious, it is usually found on the pine (*Pinus sylvestris*), the black pine (*P. laricis*), *P. pinaster*, *P. strobus*, and more rarely on *Abies alba*, *Picea excelsa* and *Larix decidua*. Larvæ are sometimes found right on into November, and, at Wiesbaden, have even been found in December; such late larvæ must certainly spring, one suspects, from moths which did not emerge until late in the year, although possibly not belonging to a second generation. Ratzeburg says that, although Bechstein reckons the species among those more than usually injurious to forests, yet no recent observations have confirmed the statement, although it is probable that it sometimes deserves the epithet, for, in some years, and always in common with the larvæ of *Dendrolimus pini*, it is very abundant locally, *e.g.*, in the Annaburg preserve in the years 1837 and 1838, when both species were in exceptional numbers. Chaumette says that, in Switzerland, the larva is found in August and September on *Abies excelsa* and *Pinus sylvestris*. Larvæ are to be found in the Linz district from July to September some were taken at Pfeningberg on September 14th, 1896 (Himsl), chiefly in August and September in the Netherlands (Snellen), captured from August 8th-September 17th, in the Auvergne district (Sand).

LARVA.—*First instar:* Short, stout and active, body cylindrical with a well-marked lateral flange for so young a larva. Head and thoracic segments large; caudal horn very stout and fleshy-looking, with a very marked fork at the top, this fork is strongly-developed and the prongs much thicker and heavier than in any other Sphingid larva that I have examined; the horn and its bifurcations have a curious worm-like appearance owing to their smooth surface and slight irregularities of thickness and direction; the surface of the horn shiny, chitinous-looking, somewhat irregularly granulated, but devoid of spicules or hairs except the setæ arising from tubercles i at apex of fork. The colour of the body dirty-yellowish; scutellar plate not very noticeable; true legs black; prolegs with black chitinous plate on outer sides; subsegments poorly marked, the abdominal segments subdivided into 8 subsegments; setæ fine, but long compared with those of *Celerio gallii* and *Theretra porcellus*, fairly stiff and tapering to a point, and rising from conical, somewhat inconspicuous chitinous brown tubercular bases; on the abdominal segments, the setæ i and ii are arranged trapezoidally, nearly as if at the four corners of a square and apparently with only one subsegment between; on the meso- and metathorax i and ii are on the same subsegment, and the same chitinous plate appears to carry both setæ, although their bases are slightly apart, i appears to be placed outside, ii just within; iii is a slightly larger seta, placed vertically above the spiracle; on the meso- and metathorax this is a two-haired tubercle, each seta with its own separate base on a common plate, the setæ placed one above the other, and both rather higher than is iii on the abdominal segments; iv and v are situated on a lateral flange, iv almost directly beneath the spiracle, and v far forward on the anterior margin of the segment, and almost on a level with the spiracle; on the meso- and metathorax only one seta is present on the lateral flange, this is situated just in front of the centre of the segment and would appear

from its position to be iv, but, judging by analogy with other species, is probably v; on the prothorax the prespiracular seta (v) appears to be duplicated and both setæ are situated on the same chitinous plate; the dorsal tubercles are, as usual, arranged in two transverse rows, one on the anterior. the other on the posterior, margin of the scutellar plate; vi is present beneath the lateral flange. The surface of the head rather granular; the pale areas thereon mottled or tesselated with dark colour [Bacot. July 20th, 1901]. *Before the first moult*, the larva is yellowish-brown with a broad brownish dorsal stripe, light-margined on either side, and with a short black horn; a yellowish stripe runs across the brown legs, whilst, at the sides of the dorsum, is a line of the same colour; head margined with blackish-brown (Bartel, *Pal. Gross-Schmett.*, ii., p. 48). *First instar:* The young larva (emerged from egg July 29th, 1882) was of a light greenish-ochreous, with the two lobes of the head broadly marked with dull black-brown; the anterior legs were black, the ventral prolegs were barred outside with dark brown just above the feet, the caudal horn, which was a little flattened and slightly bifurcate at the tip, was dull brownish-black; a faint brownish dorsal line was just visible. After feeding for two or three days on *Pinus*, the body became greener and showed faintly paler green subdorsal lines and a faint yellowish spiracular line. On August 5th, some of the larvæ were laid up to moult, their skins shining green, with the front edge of the second segment pale cream colour, in striking contrast to their copper-coloured heads, marked with blackish on each lobe. *Second instar:* On August 6th one had accomplished its first moult; its head, which was very similar in shape to that of the larva of a Smerinthid, was now of a pale green, marked with a black streak down each lobe from the apex of the crown, the black streaks shortly afterwards were margined externally with yellow streaks, the upper lip outlined with black and the mouth black; the body was green, the back being of a deeper green than the sides, with subdorsal lines of whitish-green, and with a fine whitish-green lateral line followed by a stripe of the same deep green colour as the back, which blends a little below into a yellowish whitish-green spiracular stripe, that is abruptly contrasted beneath by the deep-green belly; the black caudal horn on the twelfth segment was of the same shape as before; all the legs as before. By August 9th several of the larvæ had grown to be 14mm. long. *Third instar:* On August 12th several had moulted the second time; the green colour was full and bright, the pale yellow lines were of about equal stoutness, the spiracular line being just the least degree the stouter, the yellow stripes on each side of the head were bright, edging the black stripes; the caudal horn was reddish-brown and glossy, with the tip black, slightly bifurcate and flattened; the larvæ at this time no longer ate along the side of a needle-leaf, but attacked it from the end, biting it quite through, and thus continued to munch, gradually stepping backwards as they shortened the needle, till the needle was consumed close up to the sheath at the twig or stem. *Fourth instar:* Between August 16th and 18th several of the larvæ had moulted the third time. The spiracular line was now a little interrupted at the end of each segment; the head, the anterior legs and ventral

prolegs were now glossy, smooth and red, and the hinder half of the anal prolegs, anal flap and rough caudal horn were glossy, but with minute black points; the caudal horn was now curved, and, viewed in profile, tapered to a rather fine point, but, viewed from above, was seen to be slightly forked at the blackish extremity; the spiracles were red, finely outlined with black. *Fifth instar:* Between August 26th-29th most of the larvæ moulted for the fourth time, and, on the last day of August and September 1st, I figured the most advanced (pl. xxii., fig. 31), which was then 2in. 5lin. in length, its proportions were slender, the head somewhat bluntly conical, the segmental divisions were rather deep, as were also the subdividing wrinkles, eight in number on each segment beyond the thoracic segments, excepting the 12th, which bore the rough curved caudal horn; these deep wrinkles were blackish-brown and made the segments appear like a series of rings. The colouring and design of the larva were now very beautiful, the skin soft and smooth, the head, plate of second segment, the anterior legs, ventral prolegs, the hinder parts of the anal prolegs, the anal flap and the caudal horn were all as glossy as if highly varnished, and were sprinkled with raised black dots; the broadish dorsal stripe became gradually thicker towards the middle of each segment and then narrowed as gradually towards the end, the white or yellowish stripe by which it was bounded was consequently thicker at the beginning and at the end of each segment than in the middle; this was beautifully relieved by a stripe of the full and bright green ground-colour, followed by another or subdorsal white stripe, which also gradually widened to the middle of each segment, in which was set the orange-red spiracle, edged with black; close beneath this was the slightly inflated pale yellowish spiracular stripe, interrupted at the end of each segment; the belly was wholly of the green ground-colour; the head was orange-reddish, more or less tinged with greenish, the deep yellow stripes at the side were bordered in front with rather dark red and behind with deep red, the latter bordering being broader below and shading above gradually into the ochreous-green colour of the back of the head. By September 3rd, this larva had grown to be 3in. 2lin. when stretched out, and the white stripes were becoming interrupted in the middle; the front edge of the second segment (next the head) was of a dark-blue green, and a streak of shining reddish-black was situated in front above the base of each of the anterior legs. This larva went down for pupation on September 5th (Buckler). The *fullgrown larva* is smooth and elongated; the anal horn slightly curved; the head round; the ground-colour fine sage-green, wrinkled transversely with dark brown; a very broad pinkish-grey dorsal line, somewhat dilated towards the posterior part of each segment, bordered by an interrupted whitish line, on either side of which is another whitish, and rather interrupted, longitudinal line; also an interrupted, pale yellow, lateral line just below the stigmata, between which and the longitudinal whitish line above-mentioned, is another irregular and macular ill-defined line. Abdomen green, wrinkled with black, and a patch of dull pinkish-yellow in the middle of each segment; the stigmata orange-red, bordered by black. Head pale yellowish-brown, with two short and thick black dashes above,

and streaked on the sides with brown, more or less dark; mandibles shining brown; caudal horn black and slightly granulated. Thoracic legs very pale straw-colour, and slightly tipped with brown. Prolegs dull pinkish-yellow, with two grey patches on each. Escutcheon dark shining brown, traversed by the fine dorsal and longitudinal lines, which appear of a pale buff colour (Chaumette). Larva lævis, glauca, linea laterali flava. Caput luteum. Collum luteo nigroque varium. Segmenta lineis transversis 8 nigricantibus penultimo cornuto; ultimo punctis nigris, scabro. Cornu nigrum, scabrum, apice bifidum (Linné, *Sys. Nat.*, xiith ed., pp. 802-803). There is a very detailed description of the larva from hatching to pupation (in 6 * instars) by Hartig in Liebich's *Allg. Forst-und Jag.-Journ.*, vi., p. 177; the larva is also mentioned by Ratzeburg, *Forst-Insecten*, ii., pp. 74 *et seq.*

Variation of larva.—The adult stage of the larva of *H. pinastri* is very variable, as shown by the figures in various works. The variations arise on the one hand from the struggle between the green ground-colour and the reddish-brown extending from above, and, on the other hand, from a more or less complete disappearance of the associated longitudinal lines. The latter are sometimes completely retained, this being the case in a caterpillar figured by Hübner (*Larvae, Sphinges*, iii., Legitimæ C, *b*), where both the subdorsal and supraspiracular lines are continuous from segment 11 to segment 1, an instance which may, perhaps, be regarded as a reversion to the primary form. It has long been known that, in the larva of this species, the mixture of brown and fir-green, interspersed with conspicuous light yellowish and white spots, causes the adult larva to present a very perfect adaptation to its environment. Roesel says: "After eating, the larva remains motionless, and is then difficult to see because it is of the same colour as its food, since its brown dorsal line has almost the colour of the pine-twigs, and who is not familiar with the fact that, beneath the green needles, there is also much yellow to be found." This adaptation to the needles and twigs obviously explains why this larva, in the adult condition, is so far removed from those of *Sphinx*, with which the moths are so nearly related (Weismann). Thellusson states that the larvæ found at Woodbridge were most variable in colour, some bright green, others, in their last two stadia, varying from green to brown, whilst others again were quite purplish in hue. Ratzeburg notes that, before pupation, the larva shrinks much and often changes its colour most strikingly.

Development of larval markings.—*First instar:* The larvæ are 6mm. in length on emergence, of a light yellow colour; the head shining black with a yellow clypeus; the caudal horn, forked at tip, is at first yellowish, but soon becomes black, no particular marking present, but a reddish stripe extends along the region of the dorsal vessel, and the course of the spiracles is marked by an orange-red line (*Studies in Theory of Descent*, pl. vi., fig. 53 A-B); as soon as the young larva is filled with food it acquires a greenish streak. The first moult occurs after 4 days. *Second instar:* Immediately after the first moult there is still an absence of distinct markings, with the exception of a greenish-white spiracular line; in the course of

* Buckler and Weismann both agree (see pp. 283-284 and 285-286) in giving the larva of this species only 5 instars.

some hours the original light green ground-colour becomes darker, and, at the same time, a sharp, greenish-white subdorsal line appears, together with a parallel supraspiracular line; the dorsal line is absent; the head is light green, with two narrow blackish-brown lines surrounding the clypeus; the horn and thoracic legs black; claspers reddish-green; length 12mm.-13mm. (fig. 54). The second moult takes place after another 4 days. *Third instar:* Neither colour nor marking is affected by the second moult; only the horn, now no longer forked *, becomes brownish with a black tip. The caterpillars are now, as before, admirably adapted to the pine-needles, on which they feed by day, and from which they can only be distinguished with difficulty. *Fourth instar:* The third moult also brings no essential change, the ground-colour and marking remain the same, only the spiracles, which were formerly dull yellowish, are now of a vivid brick-red. The horn becomes yellowish-red at the base. *Fifth instar:* The marking is only completely changed in the fifth and last stage. A broad reddish-brown dorsal line replaces the subdorsal, more or less completely. The supraspiracular line also becomes broken up into numerous short lengths, whilst the green ground-colour in some specimens becomes more or less replaced by a brownish shade extending from the back to the sides. Horn black, the upper part of the 1st segment with a corneous plate, similar to that of the *Deilephila* larvæ. The entire change of the marking from the 4th to the 5th stage depends upon the fact that the young larvæ resemble the needles of the pine, whilst the adults are adapted to the branches. The ontogeny of this species makes us acquainted with three different forms of marking: (1) Simple coloration without marking. (2) A marking composed of three pairs of parallel longitudinal lines. (3) A complicated marking, arising from the breaking up of the last and the addition of a darker dorsal line (Weismann).

Cocoon.—The larvæ go some little distance below the surface of the earth and form an earthen cocoon in which to pupate. They prefer to go into the ground near the trunk of a tree to form their puparia (Bartel). The pupæ are readily found at the roots of pines under the moss (Ratzeburg). The cocoons are made at the foot of trees of *Pinus sylvestris*, at a depth of about 3ins., in the Namur district (Lambillion).

Pupa.—This pupa is not easily distinguishable, except by its size, from that of *Sphinx ligustri*, and, as a matter of fact, I had a pupa of *S. ligustri*, correctly named, which happened to be a very small specimen, and it took me some little time to satisfy

* Poulton writes (*Trans. Ent. Soc. Lond.*, 1886, p. 143): "In the spring of the present year, 1886, I had the opportunity of examining three well-preserved specimens of the larvæ of this species in Lord Walsingham's collection. Two of the larvæ appeared to be mature, and, at any rate, were in the last stage, but, in all three, the horn was strongly forked. . . . It is thus clear that Weismann was mistaken in thinking that the character disappeared at the 3rd stage. In *H. pinastri*, the feature is not only more prominent, but lasts for a longer period than in any other Sphingid larva yet described." It would be well to know whether the larva of this species ever does lose its horn at the 3rd stage as described by Weismann, or whether Weismann's descriptions are generally loose and unreliable. Bacot notes having two adult larvæ, both showing the forked character of the horn, which was much more distinct, however, in the 4th instar.

myself that my first impression, that some mistake had occurred, was erroneous. The most definite difference is in the sculpturing of the abdominal segments—in *H. pinastri* wrinkling almost throughout, whilst, in *S. ligustri*, pitting is always present, and even predominates. This gives the pupa a less polished, rather dull, look, whilst on closer examination, the sculpturing is found to differ in a good many details. The lateral spines of the anal spike also are less well-developed and nearer the extremity. The first femur, which is hardly represented, and is occasionally absent, in *S. ligustri*, is quite invisible in *H. pinastri*. The following measurements of the pupa appear to be the most important:

MEASUREMENTS AT	DISTANCE FROM ANTERIOR EXTREMITY TO	TRANSVERSE DIAMETER AT	ANTERO-POSTERIOR DIAMETER AT
Base of proboscis and anterior margin of prothorax	0·6mm.	3·0mm.	4·0mm.
Posterior margin of prothorax and base of 1st leg	3·0 ,,	5·5 ,,	7·5 ,, with trunk 6·0 ,, without trunk
Middle of mesothorax (or summit)	5·5 ,,	8·0 ,,	9·5 ,, with trunk 8·0 ,, without trunk
Posterior margin of metathorax ..	9·0 ,,	9·7 ,,	9·4 ,,
End of antenna	14·5 ,,	10·5 ,,	10·0 ,,
End of 1st leg (posterior margin 2nd abdominal)	15·0 ,,		
End of 2nd leg (front 4th abdominal segment)	18·0 ,,	10·4 ,,	10·0 ,,
End of wings	20·0 ,,	10·8 ,,	10·3 ,,
Middle 5th abdominal segment ..	23·0 ,,	9·8 ,,	9·5 ,,
Middle 6th abdominal segment ..	26·0 ,,	9·0 ,,	9·0 ,,
Middle 7th abdominal segment ..	30·0 ,,	7·5 ,,	7·4 ,,
Middle 8th abdominal segment ..	33·0 ,,	6·0 ,,	6·0 ,,
Base of anal spike	35·5 ,,	1·6 ,,	1·5 ,,
Total length	37·5 ,,		

These measurements show that the pupa is slightly flattened for the greater part of its length. The measurements do not demonstrate, however, the fact that the flattening is greatest dorsally, especially over the 3rd and 4th abdominal segments, and that there is ventral prominence at the same region, giving an appreciable trace of the S-curve, occurring in Sphingid (*sens. restr.*) pupæ. This flattening curvature, with the wrinkled sculpturing, shows that this pupa is more specially Sphingid than is that of *Sphinx ligustri*. The extreme anterior of the pupa is the head, about $\frac{1}{3}$ back from the base of maxillæ to the prothorax. The eyes have the convexity about 30° from directly forwards. The middle (transverse) plane of the pupa would be very little in front of the anterior border of the prothorax, which slopes forwards; if the maxilla-case (or -horn) were absent, the most forward point of the pupa would be little dorsal to the ventral surface. The sutures marking out the labrum can be made out, but the rest of the head is well wrinkled, but with no very definite features, except a trace of dorsal suture (the headpiece being ventral, this is rather incorrect, but it is in line with suture on prothorax) and the glazed eye, which has the

usual glazed line, with smoother piece (broader inside) on each side of it, with radiating wrinkles. The maxilla-case is nearly 5mm. long, with 4mm. free, but is very closely appressed to the pupa so that it is straight and no light is seen between it and the pupa. It has a deep median suture, the halves strongly wrinkled transversely and the wrinkles minutely subwrinkled. The rest of the maxillæ and the legs are very minutely wrinkled or rather with very flat tubercles, arranged as if they were the remains of nearly obsolete fine wrinklings. The antennæ are divided into segments, each segment subdivided by one transverse and one or two obliquely longitudinal impressed lines. The prothorax has a longitudinal dorsal suture, and the well-marked wrinklings, though irregular, have some tendency to be arranged concentrically to the middle of each lateral half. The mesothorax has an indication of an obsolete mediodorsal suture. There is the suture-like smoothness at about the line of the inner edge of the patagia. The sculpture inside these is transverse wrinkling, anastomosing and tending to have a central focus in the median line, not far from the posterior border of segment. The wing-bases are prominent with sculpture that is rather irregularly tubercular than wrinkled but with no definite tubercles or points. The wings are finely wrinkled, coarser, and with a transverse arrangement basally, finer, and with longitudinal lines more numerous, towards hind margin ; the nervures can be made out, but not with facility; Poulton's line is obvious as a fine line, free from sculpture and with the margin beyond (about 0·3mm. wide) with regular longitudinal lines ; it is also visible on the slip of hindwing which, yielding to the 1st abdominal spiracle (of 2nd segment), disappears opposite the 2nd. The maxillæ and wing-apices terminate very accurately at the margin of the 4th segment. The metathorax is narrow, has two small transverse ridges on each side of the middle line, and is elsewhere wrinkled in a fairly regular pattern. The abdominal segments are finely but boldly wrinkled. The 5th abdominal segment presents dorsally, along its anterior margin, in the hollows of the wrinkles, points that have some resemblance to pits. These become more definite on the 6th and 7th, and are pits, pure and simple, on the 8th, though wrinkling rather than pits still holds the posterior portion of that segment; 9 is entirely pitted. This transition from wrinkling to pitting, passing backwards along the segments, is more advanced ventrally, though even here wrinkling holds place towards the posterior margin even of the 7th segment. Subsegmentation is not well marked; dorsally, a narrow anterior subsegment may be seen on the 2nd abdominal and following segments, but the intersegmental subsegment is in doubtful evidence even in the most favoured position for detecting it, *viz*, behind the 3rd and 4th spiracles. In one or two specimens, on the 2nd and 3rd abdominal segments, the dorsum is divided into four tolerably equal subsegments, and, on the 3rd segment, further subdivisions may sometimes be made out, as if into 5, the first and last being widest and the 4th perhaps even further subdivided. In some specimens no subsegmentation can be seen. The scars of prolegs vary a good deal, usually each is a slight depression with a small smooth area as its posterior margin towards which sculpturing radiates and dies out. In one specimen the whole

area was raised, with a definite sulcus round its anterior border. Few specimens are quite without, and one or two have, very markedly, a deep little pit at the outer margin of the propedal scar, this has nothing to do with the scar, as, in the specimens which show it best, it also occurs on segment 7. It probably represents the triple-haired tubercles that occur here in the larva. The scar of the larval horn may be merely a small smooth area, more usually it is a definite little rounded raised protuberance smoother than its surroundings and with a slight hollow behind it. The anal spike is 2·0mm. to 2·6mm. long, and about 1·5mm. in diameter at the base, not narrowing so rapidly towards the base as apically, but varying much in this as in other particulars. An odd specimen is found with the spike almost identical with that of *S. ligustri* (which varies less), but most have the lateral points nearer the end and smaller, others have them nearly obsolete, one or two have them larger, or with several irregularly placed; the end is bifid, basally it is wrinkled coarsely, as coarseness goes in this pupa. Anterior to the spiracles and thence dorsally for a length of about 4·0mm., there is, on the anterior margin of segments 5, 6 and 7, a quite smooth surface margined by rather sharp raised ridges, the posterior being the Sphingid prespiracular flange, and a third slight ridge can be barely seen, deep in the incision, when the segment is well bent to the other side. The anal scar is a longitudinal impression about 1·4mm. in length, often narrow in front, wide behind, and, usually, with raised margins. The male tubercles are two raised smooth eminences with a depression between them and enclosed by a circular (or nearly so, it is usually a little wider transversely) groove. They occupy nearly the whole width, but rather encroach on the posterior, avoiding the anterior, margin of the 9th segment. The incision in front, however, is smoothed out to about the same degree as that behind. In the female, these incisions are still more smoothed out, but have little of the usual appearance of the posterior segments having been drawn forwards into the anterior. There is a round pore in the middle of the 8th segment, but with the appearance of really belonging to the 9th, and another half-way between this and the anterior margin of the segment, the latter being continued as a narrow slit to the anterior margin of the segment. In another specimen (one only) both these pores are united in a deep, wide impression, extending from the middle of the segment to its anterior border. In another, both are very distinct and separated; the anterior one is in the middle of the segment, the other behind it, the slit extending to the anterior margin of the segment is a mere faint line and does not extend to the pore. In another, the two pores are conjoined, but distinct from the faint line extending to the anterior margin of the segment. The first and third of these varieties are the more numerous. The microscopic aspect of the pupa shows the pits to be pale with shading radiating from the centre to the irregular margins. In showing the transition from pits to wrinkling, the 8th abdominal segment is most instructive. From the pits radiate, generally laterally, one, two, or more of the fine dendritic lines that mark the bottoms of the sulci between the wrinklings, and, when they are numerous, present a similar pattern to nerve cells with their dendritic branchings. Hairs are

very difficult to find; several, very short and baton-shaped, exist in the narrow area between the two most forward ridges of the prespiracular flanges. As regards these flanges, the spiracles concerned appear to be pushed back by the flange, having the wrinkling behind it thickened as if pushed together and puckered up. The spiracles have special marginal fringes, the margin of the first (external false) appears to be smooth and without spicules. The labrum is well marked out, and has a lower margin with three convexities, and beside it are two separate chitinous patches that are very probably the mandibles (Chapman). Long and slender compared with the pupæ of Amorphids, red-brown in colour, the dorsum rather darker, the skin somewhat rugose, the dorsal area wrinkled transversely. The head prominent, the maxillæ partly enclosed in a separate case almost ·25in. long, closely appressed to venter; two maxillary filaments, however, are placed medio-ventrally, and terminate at the apices of the wings; the glazed-eye forms a small, somewhat rugose, lunular structure; the two pairs of legs are distinctly marked; the antennæ reach two-thirds towards apex of wing, segmented, each segment with a tiny knob, the wings with raised nervures. The prothorax prominent, the mesothorax large, and swelling out at the wing-bases; the prothoracic spiracle at the junction of the pro- and mesothorax, and in contact with the antenna at its lower point, blackish in colour; the metathorax narrow. The abdominal segments increasing in size to 4, and then decreasing to anus; movable incisions between 4-5, 5-6, 6-7, the incisions much better developed laterally than dorsally; the centre of the dorsum of 4, 5, 6 and 7 slightly depressed; abdominal spiracles narrow linear slips with moderately-prominent margins, and placed well forward on each segment; ventrally, abdominal segments 5 and 6 show scars of larval prolegs; sexual organs distinct; the cremastral horn slender with bifid tip (Tutt. March 28th, 1897). 40mm. in length, cylindrical, with the tongue-case just like that of the pupa of *Sphinx ligustri*, but only 5mm. long. The abdomen tapers to the anal segment. The rough anal spike longer and more slender than in *S. ligustri*, with two pairs of short spines in its sides, and a pair at the tip. The pupa-skin is granulated, and dark red-brown in colour (Hellins).

PUPAL PERIOD.—Richenau, who has made observations on this species in the Mombach pine forests, states that there is there a complete second and a partial third brood, with correspondingly short pupal periods (Rössler), but one suspects that such appearances are rare, and that the ordinary pupal period extends from August-September to the following May-June. Schmid notes that the pupal stage sometimes extends over two winters, and Hellins mentions (Buckler's *Larvae*, &c., ii., p. 113) a pupa which remained two winters* in this state.

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* Buckler notes (*Larvae*, &c., ii., p. 27) that he reared these larvæ in 1882, and that they pupated in September, 1882; Hellins states (*loc. cit.*, p. 113) that he bred moths from these pupæ from June 24th-30th, 1884, and one, which remained two winters in the pupal state on June 29th, 1885. This would make two and three years respectively; possibly an error by Hellins as to the year in which the specimens emerged.

FOODPLANTS.—*Pinus sylvestris* (Lambillion), *P. laricis*, *Abies alba*, *Picea excelsa*, *Larix decidua* (Bartel), *Pinus strobus* (Ochsenheimer), *Abies picea*, *A. pectinata* (Snellen), *Pinus maritima* (Trimoulet), *P. pinaster* (Godart), *Pinus abies* (Heinemann), *Cedrus libani*, *Cedrus deodara* (Waller).

PARASITES.—*Amblyteles proteus*, Christ (Holmgren), *Ichneumon pisorius*, Linn. (Hartig).

HABITS.—The imagines have much the same habits as *Sphinx ligustri*, pairing readily in the evening and remaining *in cop.* all the next day, separating at dusk, when the ♀ almost directly commences oviposition (Head). The imagines are attracted to flowers in the evening, at dusk, preferring honeysuckle over arbours in villages near pine forests (Ratzeburg), at flowers, preferring *Saponaria officinalis*, flying from before dusk until completely dark, for about an hour, at Biedenkopf (Rühl), at flowers of honeysuckle at Aldeburgh (Hele), at flowers of *Saponaria* at Modena (Fiori). It comes occasionally to light, *e.g.*, not common in June, 1892, but somewhat abundant from May 3rd, 1893, at electric light at Berne (Hiltbold), also at Aigle, at electric light, July 3rd-4th, 1898, from 9.15-10.20 p.m. (Lowe), very abundant at electric light in July, 1896, at Aix-les-Bains (Agassiz). The species comes to sugar in Saxon Upper Lusatia (Schütze), and at Dresden (Steinert). In the daytime it is very sluggish, sits on the trunks of firtrees near Woodbridge, and will not fly even when moved off the trunk, but drops into a box held underneath (Thellusson), about 40 were taken in 1882, at Aldeburgh, being captured at rest on the trunks of Scotch firs, from about 4ft.-14ft. from the ground in every aspect, apparently without regard to wind or weather (Hele); occurs commonly on the pine trunks about Namur at a height of about 3ft. from the ground (Lambillion); is to be found at rest during the second week of June, 1900, on the Sacro Monte, sitting on the pine-trunks at a short distance from the ground, but the specimens are very difficult to see, as, in colour, they assimilate marvellously with the rough lichen stained bark (Lowe). Treitschke mentions (*Die Schmett.*, x., i, pp. 137-138) the pairing of a ♂ of *Smerinthus ocellata* with a ♀ of this species, whilst Bartel notes (*Pal. Gross-Schmett.*, ii., p. 50) the pairing of a ♂ *H. pinastri* with a ♀ *Mimas tiliae*.

HABITAT.—Inhabits the pinewoods throughout Europe, Asia, and probably North America, occurring abundantly in many localities, and spreading for some distance up the mountains. In the Hartz mountains it reaches the moor districts, probably spreading there from the lower forest region (Hoffmann); but, although so widely distributed, it usually only occurs somewhat sparingly in most of the old pine forests of Europe, it is, however, not confined to these, being also found in young plantations, as well as in pine thickets that have long been isolated (Ratzeburg); at Arcachon it occurs in the pine-forest that has been planted on the Landes, the species of pine on which it occurs being *Pinus maritima*, whilst, in Spain, it occurs throughout the old pine-forests of the Albarracin district to an elevation of at least 5000ft. (Chapman); it is common on the Sacro Monte, a park consisting chiefly of giant pines (Lowe).

SUMMARISED HISTORY OF HYLOICUS PINASTRI AS A BRITISH INSECT.—Donovan, as far back as 1800, refers to a "traditionary

report" of *H. pinastri* being British, the locality whence the specimens came being vaguely given as "Scotland." He further notes that, "as it is generally admitted on this authority to a place in the cabinets of English insects," he cannot refrain from giving it a place in his *Natural History of British Insects*. Haworth, in 1803, mentions that it occurs "in the month of June," and that it is to be found on the trunks of pines, "and is taken near London very rarely." Stephens, in 1828, is more exact, and mentions "one specimen taken in June, near Colney Hatch wood, about 30 years ago, and a second in the neighbourhood of Esher." This takes us back to the time of Haworth, and affords a clue as to the amount of his (Haworth's) information about the species. Stephens, however, adds that, "at Rivelston Wood, near Edinburgh, one specimen was taken by Dr. Leach, and several by Mr. Wilson, of the College." In 1842, Marshall states (*Ent.*, i., p. 231) that he saw a living specimen in Cumberland in 1827 or 1828. At the February, 1860, meeting of the Entomological Society of London (*Zool.*, p. 6940), Sealey exhibited a specimen which was stated to have been taken in a firwood near Romsey, in June, 1859, by a Mr. Morris, but the latter's brother, who had added Swiss specimens to the collection, said that he remembered taking the example himself in his own garden (see *Ent. Wk. Int.*, vii., p. 193). We next find records of single specimens said to have been taken 6 years previously, one by Miss Bicknell at Hinton St. George, and now in the Museum at Crewkerne* (Spiller, *Ent.*, vi., p. 103), and the other in (?) Devonshire*, captured 11 years previously, by Miss Jones (Purdue, *loc. cit.*, p. 127), the latter example reported to have been taken in September, 1861, a remarkable date for the species. Higgins exhibited, at the meeting of the Entomological Society of London, November 17th, 1873 (*Ent.*, vii., p. 46), an example said to have been captured at Harwich in June, 1872, but, as it was shown at the same time as two *Hyles euphorbiae*, also stated to have been bred from the same place, the record need not be considered, and then we learn that Waller took one at Waldringfield in August, 1876 (*E.M.M.*, xiv., p. 136), that Frere had one emerge on August 5th, 1876, from a pupa, found near Wickham Market (*Ent.*, x., 210), that Long captured another at Tuddenham, on June 25th, 1877 (Stainton, *E.M.M.*, xiv., p. 67, 136), and Waller a third in August, 1877, also at Waldringfield (*loc. cit.*, xiv., p. 136), whilst Mrs. Carpenter obtained a larva at Leiston in 1880, and Bloomfield (*Lep. Suffolk*, p. 8) records two for 1878, at Waldringfield (see *E.M.M.*, xvi., p. 93), whilst yet another was taken by Waller, on July 14th, 1879, at the same place (*E.M.M.*, xvi., p. 93), and Bloomfield (*Lep. Suffolk*, p. 8) notes another at Saxmundham in 1879. On July 22nd, 1881, and July 23rd, 1882, Ager recorded two examples at Ipswich (*Ent.*, xiv., p. 210; xvi., p. 187), and Battiscombe gives a record for Herefordshire in September, 1881 (*loc. cit.*, xiv., p. 255), almost certainly a blunder. Previously to these records, Carrington had noted (*Entom.*, x., p. 6) that he had received letters stating that one had been "bred in the eastern counties" and that another had "graced

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* Both these examples are reputed to have been taken by ladies in gardens. One suspects a want of care in keeping really British captures separate from Continental insects, since neither was recorded as British until several years after their reputed capture.

a baker's pump at Deal." In 1882, Carrington further publishes *(Ent.*, xv., p. 210), two letters received from correspondents whom he obviously suspected of introducing the species for sale purposes into the Suffolk district, but Cooper wrote a note *(Ent.*, xix., pp. 14-15) supporting the authenticity of the Suffolk specimens, stating that Hele had taken imagines and larvæ at Aldeburgh in 1885, whilst Hele himself (Bloomfield's *Lepidoptera of Suffolk*," p. 8) says that he took one in July, 1881, and, in the following year, about 40, in July and August. In this year, Coverdale found larvæ in the same district and bred imagines, which are in our possession. Cooper's note brought a letter from Edwards *(Ent.*, xix., p. 64), stating that a larva taken in the Island of Mull in September, 1860, near Achnaeroish, produced an imago on July 24th, 1861, a second larva being taken in the same wood in September, 1861, but this died. Rendlesham obtained imagines, from which ova were obtained, in 1892 *(Ent. Rec.*, iii., p. 226), and Walsingham exhibited larvæ, received from Rendlesham, at the meeting of the Ent. Soc. of London, held on October 5th, 1892 *(loc. cit.*, p. 245). Thellusson states *(loc. cit.*, vii., p. 131) that he first found the species in August, 1891, taking 14 specimens and leaving many worn ones on the trees at Woodbridge, but the context shows that this statement refers to the 1892 captures just mentioned. He says that none were seen in 1892, an obvious error, but specimens were again captured in 1893, 1894, 1895, when many imagines, larvæ, and dug pupæ were found. Thus three larvæ were found August and September, 1893 at Waldringfield, on August 25th, 27th, and September 6th, two imagines appearing in June, 1894 *(Ent.*, xxvii., p. 246), whilst, on June 23rd, 1895, two imagines were taken, and 15 others are reported as having been captured at later dates, whilst on August 2nd, 1895, some 100 larvæ were feeding *(Ent.*, xxviii., pp. 232, 257), and the species seemed to have become firmly rooted in the county. But disillusionment came, and Cambridge (*Ent. Rec.*, vii., p. 218) did a real service to science, as well as to all students of the distribution of our native fauna; when he explained how a direct and apparently successful attempt had been made to acclimatise the species in Suffolk, and those of us who possess Suffolk caught and Suffolk bred examples no doubt owe our specimens indirectly to these introductions. Why those who introduced the species into Suffolk did not notify the same to the entomological magazines it is difficult to say, but we do not here propose to discuss the subject further. The only other records that we have observed are: In 1884, Watkins (a dealer) states that he took a specimen on May 26th, off the palings of West Wickham Wood *(E.M.M.*, xxi., p. 34), whilst Godwin records a larva in the early part of September, 1887, near Wimbledon, which produced an imago on July 16th, 1888 *(E.M.M.*, xxv., p. 159); in 1895, Gummer records an example taken at Salisbury by his sister *(Ent.*, xxviii., p. 312), and Abbott is recorded *(Ent.*, xxix., p. 70), as exhibiting, in 1896, Sussex examples, and remarking that in that county the species had been taken in numbers recently—an obvious error! Tarbat in June, 1897, found an imago in a breeding-cage, without knowing certainly whence he obtained the pupa *(Ent.*, xxx., p. 222), whilst Douglas *(Ent.*, xxxiii., p. 250) notified

the capture of a ♂ on July 29th, 1900, on an oak trunk at Southwold (the last record of the species having been taken at large in Suffolk); an example was recorded in 1902, by Johns (*Ent. Rec.*, xiv., p. 248) as captured at Winchester on June 30th. One suspects that these records are largely due to errors, incidental to and inseparable from the attempted study of a scientific subject by a large number of poorly equipped students. A few may be due to "escapes," but there is much indirect evidence furnished, not only pointing to grave doubts as to whether the species ever was sedentary in our Islands, but also suggesting, from the gradual decadence of the progeny resulting from the Suffolk introductions, that there is no real natural tendency for the species to become acclimatised and take up a permanent residence here.

Time of appearance.—Very little, if any, evidence that the species is double-brooded, beyond the statement of Reichenau that the species has two complete and a third incomplete brood in the pine forests at Mombach (*teste* Rössler), is to be found; Fritsch certainly gives May 4th-July 6th for Austro-Hungary, with a few dates in late July and in August, chiefly at Salzburg, that might, he thinks, possibly belong to a second brood, whilst May-June and again in August-September are given for Lombardy and May and September are given for Tuscany. But there is no doubt that, even where the species is undoubtedly single-brooded, emergences are often spread over a long time. In Germany the species is recorded from May to August—in July at Schwerin, May-August at Eutin, June-July at Cassel and Kempten, in May-June at Brunswick, Alsace and Frankfort-on-Main, beginning of July in the Oberharz, May-August at Leipzig, Thuringia and Baden, and until September at Wiesbaden; May-July in Switzerland, May-June in Hungary, but continuing into July at Fünfkirchen, end of June and commencement of July in Roumania. Bartel notes June at Boulogne (certainly near enough to the British Islands), Caradja gives August in the Loire-Inférieure, &c., May 25th-August 28th at Biedenkopf (Rühl), April 16th to the end of May, 1862, in Nassau (Rössler), emerges rarely in April, generally from May to July in Germany (Bartel), in July, at Aix-les-Bains (Agassiz), in June in the Kasan district (Eversmann), July 19th, 1880, at Gstein (Hormuzaki), bred June 25th-June 30th, 1884, and June 29th, 1885, from pupæ, the ova which produced these having been obtained from Leipzig (Hellins), imagines June-August—June 12th, July 15th, 28th, August 5th at Nohant, August 15th at Planet (Sand), from mid-May to the middle of July in the Inn valleys, often common, captures were made on May 21st-24th, 1896, near Riesenhof, June 2nd-3rd at Pöstlingberg, June 28th at Buchenau (Himsl), in the Netherlands, imagines are to be found continuously from June to August (Snellen), but in Belgium the imagines are usually taken in June and July (Lambillion), May 12th-June 16th, 1900, common at Orta Novarese (Lowe), bred June 2nd, 1902, and following days at Dorking, from foreign ova (Oldaker), the earliest date at Woodbridge in those years in which the species was obtained in Suffolk, was on June 8th, the species continuing to emerge until the end of July or early August (Thellusson), July 29th, 1900, at rest at Southwold (Douglas). The rest of the recorded dates for Britain may be gathered from the preceding paragraph.

LOCALITIES.—This species appears to have no real *locus standi* in the British fauna. The following places are those from which examples have been recorded, but usually the records are hopelessly unsatisfactory in matters of detail. The Suffolk records are the result of an attempt to acclimatise the species. ARGYLE: Mull—Achnaeroish (Edwards). CUMBERLAND (Marshall). DEVONSHIRE: ? Plympton (Purdue). EDINBURGH: Rivelston Wood (Leach *teste* Stephens). [ESSEX: Harwich (*teste* Higgins).] [HEREFORD (Battiscombe).] HANTS: [Romsey (Morris),] Winchester (Johns). MIDDLESEX: Colney Hatch wood (*teste* Stephens). SOMERSET: Hinton St. John (Spiller). SURREY: Esher (Hatchett *teste* Stephens), West Wickham (Watkins), Wimbledon (Goodwin). SUFFOLK: Waldringfield (Waller), Tuddenham (Long), Leiston (Carpenter), Wickham Market (Frere), Saxmundham (Bloomfield), Ipswich (Ager), Aldeburgh (Hele), Woodbridge (Thellusson), Southwold (Douglas). WILTS: Salisbury (Gummer).

DISTRIBUTION.—Throughont the pine forests of the Palæarctic and probably the Nearctic regions. AMERICA*: United States—Pennsylvania (Strecker), Canada (Reakirt). ASIA: Japan, Kiushiu, eastern China (as var. *caligineus*) (Leech, see *anteà*, pp. 279-280). AUSTRO-HUNGARY: Tyrol—Sess, near Bozen (Bartel), Taufers, Iunsbruck (Weiler), Tyrol (Hinterwaldner), Bucovina, only in the mountains—Gsteiu (Hormuzaki), Pressburg (Rozsay), Bohemia—Prague, not common (Nickerl), Carlsbad (Bartel), Carniola (Speyer), Neu Saudec (Klemensiewicz), Stanislawow (Werchratski), Galicia—Szklo, near Lemberg, Brody (Nowicki), Moravia—Brünn (Schneider), Biala, Bregenz, Budweis, Freistadt, Gresteu, Iglau, Kaschau, Kremsier, Liuz, Senftenberg (Fritsch), Eperies. not rare (Husz), Chemuitz (Pabst), Hungary—Alsó-Kubin, Zsolna (Vángel), Kocsocz, Gölnitz (Hudák), Upper Carinthia—Salzburg (Nickerl), Lavantthal (Höfuer), Upper Styria—S. Lambrecht (Kodermann), Upper Austria—Innkreise and Traunreise districts, Riesenhof, Pöstlingberg. Buchenau (Himsl), Vienna, Ungarisch-Brod, Budapest, Fünfkirchen, Grosswardein (*teste* Bartel). BELGIUM: occurs throughout (Lambillion), Brussels, not commou (Stainton), Ortho (Slégers). DENMARK: Copenhagen, &c. (Bang-Haas), Sjaellaud (Lampa). FINLAND: southern part—Oesterbotteu (Lampa). FRANCE: Aube (Jourdheuille), Calvados, rare (Fauvel), Berry and Auvergue (Sand), Fontainebleau, Valenciennes very common, woods round Paris (Godart), Eure-et-Loir—Nogent, Châteaudun (Guenée), Haute-Garonne—Fougaron, Plateau de Moutreich, Luchon (Caradja), Puy-de-Dôme (Guillemot), Paris, Lyons, Bordeaux, Lozère—Barre, common (Speyer), Var (Cantener), Morbihan (Griffith), Giroude—Pessac, Mérignac, Bruges, &c. (Trimoulet), Doubs—pine forests in the mountains (Bruand), Aude (Mabille), Loire-Inférieure—La Chapelle-sur-Erdre, Escoublac-la-Bôle (Bonjour), Saone-et-Loire recently introduced (Constant), Seine-Iuférieure—Les Essarts, Roumore, common (Viret), St. Quentin (Dubus), Aix-les-Bains (Agassiz), Indre—Nohant, commou, Sologne, Planet, Cher—Forest d'Allogny, Auvergne (Sand), Marseille district—Toulon, Hyères, &c. (Powell), Arcachon (Chapman). GERMANY: everywhere (Heinemann). northwest Germauy, general (Jordan), Rhine Palatinate, very common (Bertram), Würtemberg (Seyffler), Giessen (Dickore), Lower Elbe district (Zimmermann), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle—Dessau, Dölau (Stange), Munich, not rare (Kranz), Rudolstadt, not rare (Meurer), Mecklenburg, common (Schueider), Bremen (Rehberg), Saxon Upper Lusatia, common (Schütze), Dresden (Steinert), Thuriugia, common (Knapp), Thuriugia Wald, near Gotha, &c. (Krieghoff), Prussia, tolerably common (Greutzeuberg), Upper Lusatia, everywhere common (Moeschler), Nassau—Wiesbaden, Mombach district, Mayence, &c. (Rössler), Silesia, nowhere rare (Assmann), Ratisbon (Schmid), Pomerania, some years common (Hering). Dessau, common (Richter), Alsace—Colmar (Peyerimhoff), Wernigerode (Fischer), Brunswick (Heinemaun), Hanover, often common (Glitz), Eutin (Dahl), Lübeck, common (Paul), Braudreis (Nickerl), Hesse-Nassau—Biedenkopf, common (Jäger), Hildesheim, common (Grote), Berlin district, common (Pfützner), Upper Hartz (Hoffmann), Schwerin, Schleswig, Bergedorf, Elberfeld, Barmen, common, Hilden, Wald, Cassel, Leipzig. not rare, Fichtel-Gebirge, Kempten, Fraukfort-on-Main, the Palatinate (*teste* Bartel), Badeu, everywhere—Constauce, Carlsruhe (Reutti), Bad Boll, Bonndorf (Leech), Halberstadt, Annaburg (Ratzeburg), Spires (von Griebel), Heligoland (Gätke). GREECE (*teste* Brit. Mus. coll.). ITALY: pretty general in north and central Italy (Curò), Lombardy, Piedmont, Liguria (*teste* Bartel), Tuscany—Berge, near Lucca, Tuscan Apennines (Calberla), Modena—

* Bartel states (*Pal. Gross-Schmett.*, ii., p. 50) that this species "is replaced in North America by an allied species." The American examples in the British Museum collection are undoubtedly of this species (see *anteà*, p. 279).

Fiumalbo (Fiori), Orta Novarese, Sacro Monte, Varallo, common (Lowe). NETHERLANDS: all provinces (Snellen), Breda, rather common (Heylaerts). ROUMANIA: rare, confined to mountain regions—Kloster Neamtz, Comanesti (Caradja). RUSSIA: Baltic provinces (Sintenis), Moscow govt. (Albrecht), Volga district—Kasan, not rare (Eversmann), Transcaucasia—Borjom, Tiflis, Manglis (Romanoff), St. Petersburg, common (Erschoff), Baltic provinces, throughout (Nolcken), Livonia—Dorpat, Neu-Kasseritz, near Werro (*teste* Bartel), Gorki, Poland, Jekaterinoslav and Charkov district, Ural district, Caucasus (*teste* Bartel). SCANDINAVIA: distributed, not rare (Aurivillius), woods of Lapland, mid-Sweden, Gothland, frequent, northern Scania (Zetterstedt), southern Norway, pretty common (Siebke), Holby (Thedenius), Sweden—south and central, rare in north, Norway—south and east, ? Finmark (Lampa). SPAIN: Barcelona—Moncada (Cuní y Martorell), Catalonia (Martorell y Peña), Albarracin district—Tragacete (Chapman). SWITZERLAND: in the pine forests, up to 5000ft. in the Gadmenthal (Rätzer), Grisons—Chur, Flims, Bergell (Killias), Basle, Bechburg, common (Riggenbach-Stehlin), Berne (Hiltbold), Aigle (Lowe), St. Gallen, somewhat common (Täschler), Zürich, rare (Zeller), Winterthur, not rare (Biedermann), Bremgarten, not rare (Boll), Aargau, everywhere - Born, Belchen, Hauenstein, southern side of Pilatus (Wullschlegel), Neuenstadt (Couleru), Schüpfen, rare (Rothenbach).

Tribe: SPHINGIDI.

Genus: SPHINX, Linné.

SYNONYMY.—Genus: *Sphinx*, Linn., "Syst. Nat.," xth ed., p. 490 (1758); xiith ed., p. 799 (1767); "Fn. Suec.," ed. 2, p. 287 (1761); Scop., "Ent. Carn.," p. 185 (1763); Müll., "Fn. Frid.," p. 37 (1764); Hfn., "Berl. Mag.," ii., p. 178 (1766); Fb., "Syst. Ent.," p. 545 (1775); "Spec. Ins.," ii., p. 150 (1781); "Mant. Ins.," ii., p. 97 (1787); "Ent. Syst.," iii., pt. 1, p. 374 (1793); "Ill. Mag.," vi., p. 288 (1807); [Schiff.,] "Schmett. Wien," 1st ed., p. 41 (1775); 2nd ed., p. 9 (1801); Esp., "Schmett. Eur.," ii., p. 61, pl. vi., figs. 1—3 (1779); p. 226, pl. xxxvi., cont. ix., fig. 7 (1787); Bergstr., "Sphing. Eur. Larv.," p. 6 (1782); Bkh., "Sys. Besch.," ii., p. 94 (1789); [F. J. A. D.,] "Bork. Rhein. Mag.," p. 317 (1793); Hb., "Eur. Schmett.," pl. xiv., fig. 69, 148 (*circ.* 1800); text pp. 98—99 (*circ.* 1805); "Larvæ Lep.," ii., Legit. C. c. 2 (*circ.* 1800); Schrk., "Faun. Boica," ii., pt. 1, p. 224 (1801); Haw., "Lep. Brit.," p. 59 (1803); Latr., "Hist. Nat.," xiv., p. 130 (1805); "Gen. Crust.," iv., p. 210 (1809); Ochs., "Die Schmett.," ii., p. 240 (1808); iv., p. 44 (1816); Leach, "Edinb. Enc.," ix., p. 131 (1815); Dalm., "K. Vet. Ak. Handl.," p. 213 (1816); Sam., "Ent. Comp.," p. 244 (1819); Godt., "Hist. Nat.," iii., p. 22, pl. xv (1820); Stphs., "Ill. Haust.," i., p. 121 (1828); "Cat. Br. Ins.," pt. ii., p. 32 (1829); Meig., "Eur. Schmett.," ii., p. 142 (1830); Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); "Gen. et Ind. Meth.," p. 48 (1840); "Spec. Gen. Het.," i., p. 96 (1875); Dup., "Hist Nat.," supp. ii., p. 157 (1835); "Icon. Chen.," pl. i., fig. 1 (*circ.* 1840); "Cat. Méth.," p. 41 (1844); Wood, "Ind. Ent.," fig. 12 (1839); Westd., "Gen. Synop.," p. 88 (1840); Humph. & Westd., "Brit. Moths," p. 13 (1841); Evers., "Faun. Volg.-Ural.," pp. 108, 112 (1844); Assmn., "Schmett. Schles.," ii., p. 38, pl. xv., figs. 40 *a*—*e* (1845); Herr.-Sch., "Syst. Bearb.," ii., p. 90 (1846); Heydenr., "Cat. Lep. Eur.," p. 18 (1851); Walk., "List," viii., p. 214 (1856); Sta., "Man.," i., p. 90 (1857); Speyer, "Geog. Verb.," i., p. 322 (1858); ii., p. 28 (1862); Hein., "Schmett. Deutsch.," p. 147 (1859); Humph., "Gen. Brit. Moths," p. 9 (1860); Staud., "Cat.," ed. 1, p. 16 (1861); ed. ii., p. 36 (1871); ed. iii., p. 100 (1901); Wallgrn., "Skand. Het.," p. 32 (1863); Rbr., "Cat. Lép. And.," p. 134 (1866); Snell., "De Vlind.," p. 99 (1867); Berce, "Faun. Franc.," ii., p. 14 (1868); Nolck., "Lep. Fn. Estl.," i., p. 87 (1868); Newm., "Brit. Moths," p. 7 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 402 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 117 (1875); Curò, "Bull. Soc. Ent. Ital.," vii., p. 110 (1875); Kirby, "Eur. Butts. and Moths," p. 69 (1879); "Cat.," p. 692 (1892); "Handbook," &c., iv., p. 48 (1897); Frey, "Lep. Schweiz," p. 56 (1880); Buckl., "Larvæ," &c., ii., p. 110, pl. xii., fig. 2 (1887); Auriv., "Nord. Fjär.," p. 45 (1889); Meyr., "Handbk.," p. 298 (1895); Barr., "Lep. Brit.," p. 31 (1895); Lucas, "Brit. Hawk-Moths," p. 74 (1895); Tutt, "Brit. Moths," p. 25 (1896); Bartel, "Palæark. Gross-Schmett.," ii., p. 43 (1899). *Spinx*, Rudolph, "Handbuch," p. 81 (1766). *Spectrum*, Scop., "Introd. Hist. Nat.," p. 413 (1777). *Herse*, Oken, "Lehrb. Zool.," i., p. 762 (1815). *Lethia*, Hb., "Verz.," p. 141 (*circ.* 1822); Stephs., "Illus. Haust.," iv., app. p. 5 (1835); "List Brit. An. Brit. Mus.," v., p. 27 (1850). *Manduca*,

Hb., "Franck Cat.," p. 87 (1825). *Hyloicus*, Roths. and Jordan, "Rev. Lep. Fam. Sphing.," p 140 (1903). *

The genus *Sphinx* must be looked upon as the typical section of the whole superfamily. In 1736, Réaumur gave (*Mémoires*, ii., p. 253, pl. xx., fig. 1) the name of "Sphinx" to the larva of *Sphinx ligustri*†, and, in the 1st edition of the *Fauna Suecica*, p. 248, Linné repeated Réaumur's reference to the species, and, in all his later works, adopted Réaumur's appellation "Sphinx" as the name for his group of the Sphingid moths, quoting again in the *Syst. Nat.*, xth ed., pp. 489, &c., Réaumur's name with the references to *Sphinx ligustri*, and, throughout all our later entomological literature, the name has been indissolubly bound up with this species. The genus *(sens. strict.)* has no other Palæarctic representative, and it is in North America that it attains its greatest number of species—*kalmiae* (Atlantic States), *franckii* (Missouri), *drupiferarum* (United States), *perelegans* (California), *gordius* (Atlantic States). *luscitiosa* (Atlantic States), *vancouverensis* (Western States and Rocky Mountains), *chersis* (United States), and *insolita* (Texas), are found in this area. Linné diagnoses *(Sys. Nat.*, xth ed., p. 489) the genus *Sphinx* as follows:

> Antennæ medio crassiores s. utraque extremitate attenuatæ, subprismaticæ. Alæ deflexæ (volatu graviore vespertino s. matutino).

He then gives four main subdivisions of the genus, which we have already noted *(anteà*, ii., p. 343). The genus, as here defined, is not only heterotypical, but includes the whole of the *Sphingides*, *Ægeriides*, *Anthrocerides*, and the Anthrocerid-like Syntomids. Hübner (*Verz.*, p. 141) first reduced the genus to its present limits, under the name of *Lethia*, describing it as:

> The forewings only exteriorly with dentate stripes; the hindwings banded—*Lethia ligustri*, Linn., *prini*, Abb., *drupiferarum*, Abb., *kalmiae*, Abb., *gordius*, Cram.

It was, however, much more fully diagnosed by Fernald *(Sphingidae of New England*, pp. 127—128) as:

> Head prominent; proboscis as long as the body or longer (sometimes a little shorter); palpi moderate in size, closely scaled and pressed against the front of the head; eyes of medium size and lashed; antennæ fusiform, ending in a short, curved, ciliated seta; thorax well-developed, somewhat advanced in front of the base of the forewings, with short, erect, metathoracic tufts; abdomen cylindrical and tapering without anal or side tufts, the posterior edge of the segments armed with round spinules; fore and middle tibiæ spinose, the middle tibiæ with one pair of long spurs, the hind tibiæ with two pairs. The forewings have 12 veins (sometimes only 11) and are of medium width, with very oblique and entire outer margins. The outer margins of the hindwings are nearly entire, being but slightly produced on vein 1*b*—*Sphinx drupiferarum*, *S. kalmiae*, *S. luscitiosa*, *S. chersis*, *S. canadensis*, *S. gordius*, *S. eremitus*.

Kirby observes *(Handbook*, &c., iv., p. 47): "*Sphinx* includes upwards of 20 species, chiefly North American, with shorter bodies and narrower and more pointed wings than *Phlegethontius* (= our Cocytiids and Agriids). The hind margins are almost entire, and

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* Whilst this and the previous sheet of 16 pages have been going through press, Rothschild and Jordan have published their splendid work *Revision Lep. Fam. Sphingidae*. We are sorry not to be able to agree with the generic names used by them for this and some other species.

† Réaumur writes: "La position dans laquelle elle reste plus volontiers, lorsqu'elle ne mange point, lui doit faire donner le nom de *Sphinx*," etc.

the forewings are generally of a lighter colour varied with grey, and without the zigzag black markings so conspicuous in *Phlegethontius.* The hindwings are grey or pink with undulating black bands, and the abdomen is marked with alternate pink (or grey) and black bands, instead of lateral spots. The proboscis is shorter than in *Phlegethontius.*"

SPHINX LIGUSTRI, Linné.

SYNONYMY.—Species: *Ligustri*, Linn., "Sys. Nat.," xth ed., p. 490 (1758); xiith ed., p. 799 (1767); "Faun. Suec.," ed. ii., p. 287 (1761), &c. [NOTE.—This species has never been known by any other specific name since the time of Linné. All the references made under the generic synonymy of *Sphinx*, Linn. (*anteà*, p. 296), are referable here.]

ORIGINAL DESCRIPTION.—*Sphinx ligustri*, alis integris: posticis incarnatis fasciis nigris, abdomine rubro cingulis nigris. *Fn. Suec.*, 809. *Phalaena* prismicornis spirilinguis fusca, alis inferioribus abdomineque fasciis transversis rubris. Mouff., *Ins.*, 910, f. 12, f. 182, f. 1. Jonst., *Ins.*, t. 19, f. 1-2. Jacob, *Mus.*, i., f. 5, n. 24, t. 1, f. 24. Alb., *Ins.*, t. 7, f. 10. Swamm., *Bibl.*, t. 29, f. 1, 2, 3. Jung, *Verm.*, 108. List., *Goed.*, 71, f. 25. Roes., *Ins.*, app. i., p. 25, t. 5. De Geer, *Ins.*, i., t. 1, f. 6. Rai, *Ins.*, 144, n. 1. Goed., *Ins.*, i., p. 93, t. 24. Reaum., *Ins.*, 2, t. 20, f. 1-4. Wilk., *Pap.*, 10, t. 1, B. 3. Habitat in Ligustro, Syringo, Fraxino, Lonicera, Sambuco.

IMAGO.—80mm.—120mm. Head and thorax fawn-grey; thorax with a large dorsal grey-brown patch surrounded by a broad black-brown area, black posteriorly. Abdomen red- and black-banded with a dorsal median broken black longitudinal line edged on either side with fawn-grey. Anterior wings fawn-grey, shaded with fuscous; an oblique dark, brownish-black band, widening from apex to inner margin, the inner edge bounded in its lower half by a double line running from discoidal cell to inner margin near base, and fading into ground-colour in its upper half, the outer edge bounded by the black subterminal line running from apex to inner margin near anal angle; subterminal line edged on either side with greyish-white; the outer marginal area traversed by a brownish line; a grey-white apical patch; the discoidal lunule black; three or four black longitudinal interneural dashes running through the oblique band; basal area pinkish; fringes dark brown. Posterior wings pink with three black transverse bands, the basal one ill-developed and shading medially into the middle one; fringes brown.

SEXUAL DIMORPHISM.—In a short series the largest ♀ is 116mm., the largest ♂ 106mm., the smallest ♀ 90mm., and the smallest ♂ but one 84mm. There is a smaller ♂, 76mm., but this is rather an aberration than a specimen to be measured for secondary sexual characters. The other specimens range between, so as to make ♂ 84mm. to 106mm., and ♀ 91mm.—116mm., a fair measure of the expanse of the two sexes. Except, perhaps, a tendency for the anterior wings of the ♂ to be a little the narrower and sharper, there seems to be no difference in form, colour or marking. Before she has laid her eggs, the body of the ♀ tapers less regularly, and is even stout and blunt. The antennæ differ little in length, but those of the ♂ may reach 17mm. in length, the ♀ 16mm.; in most they are about 15mm., and they may be only 14mm.; the ♀ antenna is more slender (·6mm.) than that of the ♂ (·8mm.), and especially tapers at the extremity for a rather greater number of joints, or rather both taper for about the

last 20 joints, the ♀ fairly regularly, the ♂ slightly till about the 8th or 9th joint from the end, then more rapidly; the hair-pockets on those of the ♂ are well-developed; in both sexes there are two obvious and one half concealed rows of scales to a joint. The 1st tibial spur is 2·9mm. long in the ♂, 2·55mm. in the ♀, and they differ proportionally in other dimensions, but not apparently structurally. The hair scent-organ in the ♂ occupies the usual position below the 2nd abdominal spiracle, and is a not very large bundle of hairs about 3·3mm. long (Chapman).

Teratological examples.—(1) A specimen, bred at Walthamstow in June, 1877, had perfect forewings but was without hindwings or any trace thereof (Cooper, *Ent.*, xi., p. 70). (2) The forewings bluntly rounded, instead of lanceolate, the outer margin less oblique, &c. Both forewings alike, &c. (Freyer, *Neu. Beit.*, iv., p. 39, pl. 313, fig. 1).

Variation.—There is considerable variation in the colour of this species and albinistic and melanochroic specimens are occasionally obtained. We have an example from the "Coverdale collection," in which all the usual pink parts of the wings and the body are almost white (=ab. *albescens*, n. ab.). Schultz notes (*Ill. Woch. für Ent.*, ii., p. 706) a ♂ with partially albinistic hindwings. Pfützner describes (*Iris*, x., 1, p. 160) an interesting albinistic aberration caught in June, 1895, at Sprottau, in which the whitish markings at the apex of the forewings are more vivid than usual and the red of the hindwings has disappeared as far as the hairs at the base which show a faint tinge of this colour; the ground-colour is a dull bone-white, almost as in *S. drupiferarum* from North America; in contrast to the lack of red in the hindwings the abdomen has the transverse spots of a very intense red. Holland notes two examples reared at Reading (and now in the Reading Museum collection) in which the pink colour of the hindwings and the abdomen is replaced by yellowish, these parts being of a pale lemon-colour when the moths first emerged (=ab. *lutescens*, n. ab.). In the Briggs' collection, sold in 1896, was an exceedingly dark aberration in which the forewings, as well as the hindwings and abdomen, were all much suffused with black, the forewings with the inner margin black, the black coloration passing upwards from the anal angle to the costa just outside the subterminal line, the hindwings with three very marked black bands (*Ent. Rec.*, ii., p. 141); this example was bred in the London district (*Proc. Sth. Lond. Ent. Soc.*, 1891, p. 125) (=ab. *obscura*, n. ab.). Griffiths records the capture of a dark aberration at Stapleton in which the usual dark dorsal line was quite obliterated, whilst Manley records two specimens with the central band of the body quite black, the wings also suffused with black. Bartel observes (*Pal. Gross-Schmett.*, ii., p. 47) that, in southwest Siberia, specimens that form a transition to var. *amurensis*, and in which the red is much paler and the black richer and much deeper than in any Central European examples, are to be found, whilst he adds that, in Japan, where the species is common, it is almost like the European form. A study of the examples in the British Museum coll. shows that there is a considerable amount of colour-variation in the species. In some, the ground-colour of the forewings is whitish, with the dark areas black, the shading of the paler areas inclining to clear grey, the paler coloration of the pink parts of the hindwing being also sometimes

noteworthy; such an example is labelled "Rugen Island." Another extremely pallid specimen in the same collection is a small ♂ of fawn-grey tint, the darker areas reduced to a minimum, the basal, costal and outer marginal areas being of the pale ground-colour and without darker shading; the hindwings with the pale areas of a pink, inclining to white. In others the pale parts of the forewings are tinged with reddish, which gives them a grey-brown appearance, whilst a Westphalian example has an exceedingly rich red coloration to the hindwings. A still more remarkable aberration is one in which the pale areas of the forewings are brown with the ordinary black markings, whilst the hindwings are sufficiently tinged with brown to mask the normal red colour (=ab. *brunnea*, n. ab.). A specimen from the Frey coll. that shows sign of crippling in the shorter forewings has the median and basal bands of the hindwings united, a character that distinguishes the only Japanese example in the collection. Roughly, one may group what may be termed the normal range of variation of the species thus:

1. Ground colour whitish-grey — the basal, costal, and outer marginal areas clear; the median (banded) area not strongly shaded with darker; the hindwings pinkish-white in tint with normal black bands=ab. *pallida*, n. ab.
2. As in 1, but the median (banded) area dark, the costal, basal and outer marginal areas slightly shaded with darker; the hindwings pinkish with normal bands=ab. *subpallida*, n. ab.
3. As in 1, but the median (banded) area dark, the costal, basal and outer marginal areas strongly shaded with blackish-grey; the hindwings normal=ab. *incerta*, n. ab.
4. Ground colour fawn-grey or greyish-pink, median (banded) area brown-black, submarginal area and apex tinged with whitish-grey; hindwings normal = ab. *typica*, n. ab.
5. As in 4, but median (banded) area quite blackish, submarginal area and apex hardly tinged with grey =ab. *intermedia*, n. ab.
6. As in 4, but the tint of the black median area extended into the costal areas; the hindwings with black bands somewhat extended=ab. *obscura*, n. ab.

One aberration alone appears to have been named, *viz.*, *spiraeae*, Esper. The original description of this aberration reads as follows:

a. ab. *spiraeae*, Esp., "Schmett. Eur.," ii., supp. p. 21, pl. xlii., fig. 1 (1798); Staud., "Cat.," 2nd ed., p. 36 (1871); 3rd ed., p. 101 (1901); Bartel, "Palæark. Gross-Schmett.," ii., p. 47 (1899). *Ligustri*, Hb., "Sphing.," fig. 143 *(circ.* 1800). *Spireae*, Kirby, "Cat.," p. 692 (1892).—Alis integris: (macula baseos alba); posticis incarnatis fasciis duabus nigris, abdomine rubro, cingulis nigris. (Simillimus *Sphingi ligustri.)* Although the specific right of this moth, of which we have at present only a single bred example, is not yet confirmed by more examples, yet, according to the ordinary rules of Nature, it is likely that she has, with apparently slight deviation, formed an essentially different species, and I here give an accurate figure of this rarity sent me by Von Koy and Von Böhm. According to the gardener at Buda, he found the larva on *Spiraea chamaedrifolia*. It was strikingly different from the larva of *Sphinx ligustri*, both in size and markings, which, however, are not described. He was not able to find this larva again last year. The much reduced size already afforded a striking difference from *Sphinx ligustri*, which so seldom varies in size. The moth was a ♀ and laid several eggs which resembled those of *Sphinx tiliae;* its ♂ would, therefore, be smaller still. In form it shows also other differences—The forewings are in proportion to its small size somewhat broader and the hindwings more rounded; on the upper side of the forewings runs an oblong-round white spot, which, in *ligustri*, is never of equal breadth and colour, also, is not divided by traversing stripes and nervures. The usual black-brown "veil" is here very pale and almost lost in the brownish. *Ligustri* has, on the upper side of the hindwings, near the base, a black spot or curved band, that is wanting in our moth, and the two bands which follow are also much narrower. The second in *ligustri* stands nearer to the margin, here more in the middle. The black band on the underside of the hindwings has likewise this position, and is, more-

over, narrowed at both ends, whereas, in *ligustri*, it is of uniform width and fades off into the ground-colour, but here it is sharply defined (Esper).

Bartel notes (*Pal. Gross-Schmett.*, ii., p. 47) that this aberration was described from a Hungarian specimen, and might occur anywhere as a rare aberration with the type, whilst the larva, which is said to be very strikingly different from the typical form, both in size and markings, lives in summer only on *Spiraea chamaedrifolia*. He further adds that it will not accept the plants that serve *S. ligustri* as food. We have not noticed that Esper made this statement.

In the far East, *S. ligustri* is characteristically marked, and shows distinct racial peculiarities, the Amurland examples having been described as *amurensis* by Oberthür, and the Japanese examples as *constricta* by Butler. The original descriptions of these read as follows:

β. var. *amurensis*, Oberth., "Bull. Soc. Ent. France," 6th ser., vi., p. lvi (1886); Staud., "Rom. Mem.," vi., p. 220 (1892); Kirby, "Cat.," p. 692 (1892); Bart., "Pal. Gross-Schmett.," ii., p. 48 (1901). *Spiraeae*, Graes., "Berl. Ent. Zeits.," xxxii., p. 104 (1888).—Variété spéciale à la région de l'Amour et au nord de la Chine, plus pâle quant au rose, plus obscure quant au brun (Oberthür). DISTRIBUTION. — Amur district—near Nicolajefsk, commencement of July, very rare; Pokrofka (Graeser), Ussuri, Suifun (Dörries), near Baranowka, Sidemi (Jankowski), on the Bureja Mountains, Kidsi (Schrenk). Mandchuria—Chingan Mountains (Bartel); North China (David), Isle Askold (Jankowski).

Leech notes (*Trans. Ent. Soc. London*, 1898, p. 287) that var. *amurensis*, Obth., would appear to be identical with the Japanese form described as *constricta* by Butler. Staudinger (*Cat.*, 3rd ed., p. 101) adopts this view, and simply diagnoses the combination as "minor obscurior," a description that does not altogether tally with Oberthür's original diagnosis (*suprà*), but is characteristic of Butler's *constricta*. We are not at all satisfied from the descriptions here given that the two forms are identical. Graeser says (*Berl. Ent. Zeits.*, xxxii., p. 104): "2 ♂ s at Nicolajefsk (Amurland) beginning of July. The larvæ in autumn were very rare on species of *Spiraea*; I also found a few of them at Pokrofka; the oblique violet stripes of the larvæ of ordinary *S. ligustri* are dark red-brown in the Siberian larvæ. The imagines are strikingly small and very dark. Expanse of ♂ =80mm.; of ♀ 66mm." Staudinger says (*Rom. Mém.*, vi., p. 220): "The var. *amurensis* was found by Schrenck in the Bureja Mountains and at Kidsi, by Maack on the Amur, by Dörries on the Ussuri and Suifun, by Jankowsky at Sidemi, by Graeser at the beginning of July (2 ♂ s) at Nikolajefsk, the larvæ there and at Pokrofka in autumn on species of *Spiraea*. The three Amurland specimens before me are so strikingly darker, and also smaller, than typical *ligustri*, that they probably deserve the name var. *amurensis*, which Oberthür has already given them in the *Bull. Soc. Ent. Fr.*, 1886, p. 56. In any case the form has more right to a special name than *spiraeae*, Esp., which was given to a small pale specimen, quoted in the *Catalog* as an unimportant aberration. Graeser probably only gives his Amurland *ligustri* as var. *spiraeae*, because the larvæ were there found on *Spiraea*, otherwise his dark specimens, excepting in their small size, are just the opposite to ab. *spiraeae*, Esp. Esper also gave the name *spiraeae* to his aberration, because the larva of the specimen named by him was found on *Spiraea*, but it is well-known that the larva of *S. ligustri* is a pretty general feeder. Leech has a specimen of *S. ligustri* from Japan almost like the European examples."

Bartel observes (*Pal. Gross-Schmett.*, ii., p. 48) that this form is the opposite of ab. *spiraeae*, which is a casual, small, pale aberration of *S. ligustri;* the ab. *amurensis* is strikingly darker brown and smaller than typical specimens of *S. ligustri;* in addition, the rose-colour is paler; it is also distinguished by its very sharp markings. In size, however, the conditions are here reversed, since the ♀s are smaller than the ♂s; the wing expanse of the latter is 80mm., while the ♀s only measure 66mm. The larva of this interesting form lives, like that of *S. ligustri* and its ab. *spiraeae*, in autumn, on some Siberian species of *Spiraea*. The oblique lateral stripes, which are mostly violet in the larva of typical *S. ligustri*, are dark red-brown in those of the Amurland variety.

γ. var. *constricta*, Butl., "Cist. Ent.," iii., p. 113 (1885); Kirby, "Cat.," p. 692 (1892); Staud., "Cat.," 3rd ed., p. 101 (1901). *Ligustri*, Leech, "Proc. Zool. Soc. Lond.," 1888, p. 589 (1888); "Trans. Ent. Soc. Lond.," p. 287 (1898).—Allied to *S. ligustri* of Europe, decidedly smaller, wings much narrower and more elongated, so as to more nearly resemble *S. kalmiae* of the United States; much darker than *S. ligustri*, the paler areas being of a deep copper-brown colour (excepting the white submarginal lines), the darker area greyish-black, traversed by velvet-black lines; secondaries agreeing with those of *S. kalmiae*, in having no subbasal band, and the outer border somewhat dark but differing from it and *S. ligustri* in the much greater width of the central band towards the abdominal margin, and from *S. ligustri* in the much wider submarginal black band; body and undersurface almost the same as in the latter species. Expanse of wings 76mm. Kashiwagi, June 22nd, 1881 (G. Lewis) (Butler).

Leech sinks this variety (*Proc. Zool. Soc. Lond.*, 1888, p. 589) and writes: "One example, taken at Hakodaté by my native collector in June, does not differ sufficiently from European examples to deserve specific rank." The only Japanese example in the series of *S. ligustri* in the British Museum collection (possibly that referred to by Leech) has the forewings very suffused, the basal and costal areas dark grey-brown, the oblique banded area from apex to inner margin extended and dark; the outer band of the hindwings extending to the fringes, and the short basal one blending with the median band. Butler's type specimen of *constricta* (not in good condition) is much darker. Rothschild and Jordan write (*Rev. Lep. Fam. Sphing.*, p. 140) of *constricta:* "Structurally the same as *ligustri*. . . . The black colour is prominent, the pink colour reduced in intensity. There is as yet very little material in collections. This form is of interest in so far as it stands intermediate to a certain degree between *drupiferarum* and European *ligustri*. The antemedian and median bands of the hindwing are separate in typical *ligustri;* they are confluent in a few specimens which occur apparently everywhere among typical *ligustri*; the red colour is, besides, occasionally reduced in intensity. In *constricta* the bands are always more or less confluent and the red colour bleached, while in *drupiferarum* both characters are exaggerated, there being no red tint and the two bands being completely fused into one median band, which shows, occasionally, traces of grey scaling centrally, indicating the original three-banded state."

EGGLAYING.—The eggs are laid on the underside of the leaves of privet, those on small shoots near the foot of a hedge being preferred (Bacot); deposited singly on the underside of the leaves at Sudbury, and hatched July 29th, 1900, others hatched July 20th,

1901 (Ransom); of twenty eggs laid in confinement, 17 were attached to the underside of privet leaves and three to the upperside. The colour of the eggs harmonises better with the underside than the upperside of the leaves and it is very likely that, in a state of nature, all the ova are laid on the underside, besides which they are there more protected from rain and sun as well as sheltered from observation. Eggs laid on July 8th, 1884, produced larvæ on July 16th—18th, 1884, their development being thus very rapid (Poulton); Hellins, too, notes that eggs hatch in from 8-10 days after being laid, but eggs laid June 28th, 1885, at Painswick, hatched on July 14th (Watkins), and others laid June 28th, 1898, at Marathon, hatched July 13th (Clarke). Freeman states that he observed ova laid on tarred palings 6ft. from a lilac bush. Bartel observes that the eggs are often laid on quite different foodplants by one and the same ♀, and that there seems to take place in longer periods of time a change of foodplant. Crewe records having found eggs laid indiscriminately on ash, privet, lilac and laurustinus. Kleemann records that he obtained 400 fertile eggs from a single ♀. Levett notes the number of eggs laid by a ♀ in 1873, as 260.

Ovum.—In size and general appearance this egg is indistinguishable from that of *Amorpha populi*. Its three diameters are 2·08mm., 1·68mm. and 1·50mm., with some little variation, especially as the egg is rather sensitive to evaporation and the diameters vary a little accordingly even before the depression on the upper surface appears. It seems to have a little less gummy material on it than the eggs of the Amorphids. The surface netting does not present the same curious effects that it presents in these eggs and that seems to be due to the gummy coating. The individual cells of the netting are about 0·015mm. in diameter and are irregularly hexagonal, with a slightly roughened surface (gum?). The micropyle is very much the same as in the egg of *Amorpha populi*, a small rosette of radiating cells, rather shorter than those of the general surface and, of course, much narrower, followed by cells still a little smaller than those further out and all narrowed a little so that their length points towards the micropyle (Chapman). The egg is of a bright apple-green colour, plump in appearance, cylindrical in shape with rounded ends, the length, breadth, and height, being respectively 2mm., 1·7mm., and 1·5mm. A small shallow oval depression on the upper surface of the egg. To the naked eye, the shell appears smooth and shining, but under a two-thirds lens is seen to be covered with a minute and exceedingly fine polygonal reticulation. I am totally unable to detect the micropyle under a two-thirds lens unless it be a minute star, at one end of, and on a level with, the general surface of the egg. As the egg matures the colour becomes more creamy with certain areas only retaining the original bright green colour. The empty eggshell is transparent, shiny and iridescent, and the young larva makes a circular hole at one end of the egg for its escape. It does not eat the remainder of the eggshell. The egg is laid on its long side, and attached firmly to the object on which it is laid [Tutt. Eggs received from Mr. Christy, July 4th, 1898, described under a two-thirds lens July 8th]. Oval, without much difference between those of the axes, about 1·75mm. long and 1·5mm. wide; slightly flattened from above downwards; colour bright yellowish-green; after a few days a depression appears on the upper surface, and the colour becomes

less delicate and transparent; soon afterwards the ovum is opaque, yellowish, and mottled with bright green (Poulton). Broadish oval in outline, plump, about 1·75mm. long, and varying in width, some 1·45mm. wide, others 1·25mm. The shell is rather glossy, smooth, in colour a palish tint of full green. Before hatching the dark horn of the larva shows through the shell (Hellins).

Reputed parthenogenesis in S. ligustri.—Clogg records (*Ent.*, v., p. 357) that he obtained eggs from an unimpregnated female at East Looe in 1871, that 63 larvæ hatched between July 2nd and 6th, that he kept 10, gave away 15, and set free 38. All the 25 larvæ kept in confinement pupated, and 12 moths emerged, all barren females. Nix notes (*Ent.*, iv., p. 323) that, in 1869, he had some eggs from a bred ♀ that had no intercourse with a ♂, but that the eggs all hatched. See also *anteà*, vol. iii., p. 381.

Habits of larva.—The young larvæ eat their egg-shells in part; the amount eaten varies, but appears never to be more than three-quarters of the whole, and often there is an aperture barely large enough for emergence. The young larvæ spin webs for foothold, and readily suspend themselves by threads. This fact has already been observed by Kleemann, and it is very interesting as the habit is so entirely abandoned later, although it appears again before pupation. The disappearance of this habit probably follows from the great size and weight of the larva, which renders this method of attachment and suspension comparatively useless. It is of especial use when the larva clings to the flat underside of the leaf at any point except (that usually selected) the projecting midrib. Later the larva gains security by the extreme power of its claspers. . . . The protective resemblance of the young larva is to the underside of the leaf, and the larvæ are especially hard to distinguish when seated on the midrib, and, in this position, they seem nearly always to rest. In the second stadium the larva still rests as a rule on the midrib of the underside of a leaf. After ecdysis the skin appears always to be eaten, except the head and horn, which seem to be invariably rejected. In the third stadium the larva habitually rests in the *Sphinx* attitude upon the midrib, this position being assumed, although exceptionally, in the second stadium and is even seen in the first. The fourth stadium is, however, the stage of the *Sphinx* attitude, and the head is held higher and further back than at any other time, the position being possibly even less striking in the final stadium (Poulton). Réaumur notes (*Mémoires*, ii., p. 253) that the usual resting position of a larva is to hold a branch tightly with the crochets of its prolegs, the part of the body carrying the prolegs being pressed to the branch, whilst the anterior part is thrown back, and is held almost perpendicular to the branch—resting for hours immovably in this attitude. We have already detailed at length (*anteà*, vol. i., p. 51) the meaning of the Sphinx attitude as developed so strongly in the larvæ of this superfamily, and those of some closely allied groups. It appears to be due to the strain caused by gravity upon the anterior unsupported part of the body, together with the compensating muscular reaction. It is most marked in the vertical position of the larva with the head upwards, and also in the horizontal position wih the head downwards, and least of all in the position of the Sphinx—

horizontal with the back upwards. Réaumur further remarks that the larvæ are great eaters, and grow somewhat rapidly, whilst Rösel observes that the ecdyses follow at first at intervals of about six days, but that the period extends to about ten days after the 4th moult. Montgomery records the larval stage in captivity as extending over 56 days, but Clarke had eggs that hatched on July 13th, 1898, the larvæ going down for pupation on September 26th, the active larval stage thus occupying 75 days. As to the increase in size during the last stadium, Newport notes that a larva of *S. ligustri* which, at its last moult, weighed only about 19 to 20 grains, at the expiration of eight days, when it was fully grown, weighed nearly 120 grains. Clarke also states that, in confinement, the larvæ, in spite of being continuously supplied with fresh food, were frequently observed nibbling the tips off the caudal horns of other larvæ. Daws says that, although usually quite still during the daytime, the larvæ are readily found at dusk feeding on the top shoots of privet, and Butler has found quite small, half-grown, and fullfed larvæ on the same day, and all within 20 yards of one another, on a hedge at Reading. Réaumur notes (*Mémoires*, ii., p. 256) that, when the larvæ are about to pupate, the colours become much changed, the green becomes brown and the larvæ appear to be dirty; they are also restless, walk continually, seeking a suitable place in which to pupate; one was observed to enter and leave the earth several times during 24 hours, possibly because it was too dry, for, as soon as it was moistened, it entered the ground immediately and came out no more. Russell gives (*Ent. Rec.*, xiii., pp. 137-138) details of the travels of a larva in search of a pupating-place, this particular example crawling 59ft. in 50 minutes. Wilson is reported (*Entom.*, xi., p. 144) to state that the larva of this species moults but once, most of our authorities, however, allow it four moults, but Newport says that it moults six times. Usually the larvæ are fullfed in late August and early September (Réaumur gives September 1st-15th as a good average time at and near Paris), but sometimes they are to be found in October and early November, *e.g.*, to October 3rd, 1863, in the western suburbs of London (Clifford), up to October 27th, 1885, at Firle, near Lewes (Edgell), plentiful on laurustinus in late October, 1888, at Great Malvern, one of which did not pupate till the first week of November (Mitchell), larvæ of various sizes on September 24th, 1897, at Northampton, the earliest of which pupated on September 29th, and the latest on October 17th (Imms). The following dates of the capture of larvæ have accumulated: July-September in Upper Austria (Himsl), fullfed in September in the Netherlands (Snellen), larvæ from August 7th-September 20th (Hellins), August and September most years at Bremhill (Eddrup), larvæ in August at Romsey (Buckell), larvæ in August at Southampton and Winchester (Moberly), larvæ from July 6th-August 19th from 1886-1898 in Norfolk (Freeman), larvæ from August 22nd-September 5th, 1845, August 9th-25th, 1847, all at Brighton, fullfed larvæ on August 1st-17th, 1857, and a fullgrown one at Cuckfield on August 5th, 1858, fullgrown larvæ, August 16th, 1857, at Ovingdean (Merrifield), fullfed larvæ common on August 13th-20th, 1857, at Wandsworth (Blackmore), September 4th-12th, 1857, at Chelsea (A. H. Clarke), August 2nd-October 6th, 1858, at Barnstaple (Mathew), larvæ fullfed on August 28th, 1858, at Chatham (Tyrer), several larvæ nr. Hull (Young, *Ent. Wk. Int.*, vii., p. 5), several

larvæ in 1859 in the Carlisle dist. (Armstrong), August 12th-21st, 1860, in Sherwood Forest (Talbot), larvæ on September 11th, 1865, at Fursdon nr. Egg Buckland (Briggs), September 10th, 1870, at Odiham (Holland), August 14th, 1871, at Lee, September 2nd, 1872, at Mottingham, September 29th, 1872, at Danbury, August 4th, 1873, at Darenth, August 28th, 1889, at Mottingham (Bower), September 16th, 1876, at Hardwick, September 5th, 1880, at Reading (Holland), larvæ taken August 14th, 1881, at Yarmouth (J. A. Clark), October 11th, 1881, at Teddington, September 3rd, 1884, at Folkestone, September 2nd, 1887, at Leatherhead (T. H. Briggs), August 12th, 1882, larvæ at Folkestone, August, 1887, at Darenth, August 13th-21st, 1887, August 1889, at Lowestoft (James), September 20th, 1884, at Henley, September 10th, 1885, at Reading, September 7th, 1887, at Tilehurst, September 12th, 1889, at Mapledurham, September 19th, 1890, at Pangbourne (Holland), larvæ, September 21st-29th, 1888, September 5th, 1889, September 6th, 1890, September 13th, 1892, and September 29th, 1894, at Bristol (Bartlett), October 11th, 1888, at Brentwood (Burrows), larvæ on September 15th and 16th, 1890, at Lyndhurst (Hewett), larvæ nearly fullfed, August 30th, 1891, at Reading (Butler), August 20th, 1892, at Braunton (Bartlett), larvæ on August 29th, 1892, at Shorncliffe, September 19th, 1894, at Enniskillen (Brown), larvæ fullfed August 31st, 1892, at Marlow, August 21st, 1895, at Harrogate (A. H. Clarke), a larva at Kingsdown, September 13th, 1892 (Sheldon), larvæ on August 15th, 1894, at Llanstephan, pupated September 14th (Bingham-Newland), August 25th-September 29th, 1894, August 27th, 1895, August 31st, 1896, August 27th-29th, 1898, August 15th-September 2nd, 1899, August 15th-September 3rd, 1900, at Sudbury (Ransom), fullfed larva, September 24th, 1894, at Worcester Park (Kaye), August, 1895, at Herne Bay (Peachell), August 13th, 1895, at Rainham (Burrows), larvæ at Bournemouth, September 3rd, 1896, about three-quarters grown (Miller), larvæ on August 11th, 1897, at Reading (Butler), fullfed from August 15th-23rd, 1897, August 31st, 1898, at Oxton (Studd), 5 larvæ taken on September 24th, 1897, at Birmingham, of different sizes, pupated between September 29th and October 18th (Imms), August, 1898, at Castlemartin (Hodge), August 15th, 1898, at Llanstephan (Bingham-Newland), fullgrown larvæ during the last week in August, 1898, at Taunton (Tetley), larvæ on August 22nd, 1898, at Stalham (Edelsten), September 6th, 1898, at Freshwater (Sheldon). larvæ from September 10th-13th, 1898, at Cheltenham, September 13th-14th, 1898, at Barnstaple (Cotton), August 14th, 1899, August 7th, 1900, at Henny (Ransom), August 16th, 1899, at Malvern Wells (Sich), larvæ fullfed on September 4th, 1899, near Stroud (Redmayne), September 6th, 1899, at High Wycombe (Peachell), three larvæ found at Gravesend on July 22nd, 1900, went down July 28th-29th and August 6th (Huggins), larvæ small at Fulbourne on September 12th, 1900, larvæ fullfed on September 22nd, 1900, at Great Baddow (Raynor), larva on September 17th, 1900, at Sydenham (Swain), at the end of September, 1900, at Ingleby Greenhow (Elgee), July 31st-September 3rd, 1902, at Burgess Hill (Dollman).

LARVA.—*First instar:* Length 6mm., of horn 3mm. (exactly half the length of larva). When hatched the larva is pale green,

but, shortly afterwards, the horn becomes very nearly black. Except for the ordinary setæ of the primary tubercles, the larva is quite smooth*, *i.e.*, there are no secondary hairs, nor any very evident division into subsegments. As an exception to the smoothness of the larva, the horn (and apparently the segment about its base) is thickly clothed with short hairs, these hairs are expanded at their points, and many of them, especially towards the extremity of the horn, have a bifurcate character, being fish-tailed like those of *Mimas tiliae*. The two terminal hairs are similar to those on the tubercles, but hardly so long, and are, doubtless, the setæ of tubercles i of this segment. The setæ of the tubercles are rather long, dark, and terminate in an enlargement as of a small funnel-shaped structure, and with some traces of spiculation. In a mounted specimen the subsegments become visible, and the tubercles are placed thus—i on the 3rd subsegment, iii on the 4th subsegment, and ii on the 6th. There is a prespiracular tubercle which cannot possibly be a subspiracular (v) moved upwards, because it is very definitely placed on subsegment 2, and these subsegments are all dorsal divisions, altering, mixing, and rearranging themselves at the flanges belonging to the spiracular and subspiracular region. A subspiracular tubercle (iv) is on the lower aspect of a flange-swelling passing from behind the spiracle in some degree from subsegment 5, and running downwards and forwards. Below this is one more tubercle nearly at base of proleg. The dorsal (? i + ii) and subdorsal (? iii) tubercles on the 2nd and 3rd thoracic segments carry two setæ, one in front and one behind (in one case, the dorsal on the 2nd thoracic, has three). There are no small or secondary hairs on the general surface, those of the horn are arranged in circles round the horn, not easy to count at its base, but more evident further on, and about 130 in number. Each circle has some 12 or 14 hairs. Those in adjacent circles alternate, or the hairs in alternate rows are on the same line, or even more frequently the hairs of rows 1 and 4 are in line rather than those of 1 and 3. The alignment in this way is, indeed, a little irregular, but is sufficiently regular to give a fir-cone spiral appearance to portions of the horn in many aspects. The crochets to the prolegs appear to be about 9 in number. As the larva gets a little older the subsegments become more distinct, 8 in number, the narrow longitudinal yellow line is fairly distinct and the oblique yellow lines, though pale, are quite evident †; they are very slender, they start from i of one segment and pass to iii of the preceding segment and then on to the prespiracular, these tubercles being in its actual line, and, as in the Amorphids, suggesting that their yellow coloration originated the

* Poulton erroneously says (*Trans. Ent. Soc. Lond.*, 1886, p. 141): "In the newly-hatched larva of *S. ligustri* the body was covered with hairs or bristles, which sprang from ordinary shagreen-dots, whilst there were also two lateral and two dorsal rows of longer bristles springing from larger shagreen-dots which bore a special relation to the larval markings which appeared later," &c.

† Hellins states (Buckler's *Larvae*, &c., ii., p. 111): "When the first moult is passed . . . . the slanting stripes on the side now become visible, *i.e.*, on each subdivision there is one pale point in the line of the streak, the streaks thus being lines of pale greenish-yellow dots." The fact is these oblique stripes, as noted above, are visible in the 1st instar, *i.e.*, before the 1st moult.

idea of an oblique line, formed in them by the yellow secondary tubercles and hairs which do not exist here; a darker dorsal line is also now present. As the larva grows, the horn looks less proportionally long. It is now also evident that the fine hairs exist only on the horn, and that what at first could be easily mistaken for the surface of the segment at its base, is really a portion of the horn. Elsewhere the segments are perfectly smooth, but, in well-grown specimens, are some dark points in the oblique lines that look as if there were rough points or some representation of them beneath the cuticle; they may really be so, representing points to occur in next stadium (Chapman). The tubercles on the meso- and metathorax differ altogether in position from those of the Eumorphids *(e.g., Theretra porcellus)*, i and ii being close together not only on the same subsegment, but occupying the same chitinised skin area, i only bearing a seta, ii being largely atrophied,* while on the abdominal segments there are two subsegments between i and ii; on the abdominal segments iii is directly above the spiracle on the subsegment posterior to that bearing i; iv is beneath and slightly posterior to spiracle, whilst the prespiracular (? v) is in the same line as the spiracle, but on the front part of the subsegment anterior to that bearing i; iii, on the thoracic segments, consists of two setæ on a raised skin area; there appears to be only one subspiracular tubercle. The primary setæ are slightly knobbed at the top and there is no trace of secondary hairs; on the 8th abdominal the anterior trapezoidals (i) are placed on the top of the caudal horn. When nearly fullfed in this skin, the oblique stripes are clear and distinct, cut by the subdorsal line, which also is very clearly marked. There appear to be only 7 subsegments to the thoracic, but 8 subsegments to the abdominal, segments (Bacot). The larva just after emergence is 5·25mm. long when extended in walking, the horn 3mm. long (in some, however, the horn is nearly as long as the body). The colour of the body is a pale, transparent (very slightly greenish-) yellow, the head much greener than the body (see *Trans. Ent. Soc. Lond.*, 1885, pl. vii., fig. 1); the horn black, but the upper half transparent and greenish, the green internal fluid shining through the dark exterior, it tapers very slightly, is straight except that the upper part is bent downwards in a gentle curve, the blunt tip is bifid, and each process ends in a fine and fairly long bristle, so that the structure is prong-like when viewed from above. The body is thinly clothed with long fine black hairs, arranged in 4 rows, two dorsal † (one on each side of the middle line) and two lateral ‡ (a little above the spiracles); each of these four rows is made up of two hairs § on each segment from the 1st to the 7th abdominal (both inclusive). Posterior to the latter the hairs are more abundant, but still thin,

* Possibly only in the example examined; one suspects that the seta of ii is usually present (Bacot). Chapman adds that the setæ of i and ii are equally developed as well as the two setæ of iii, and that Bacot's example must have been abnormal.

† Evidently refer to the rows in which i and ii are placed longitudinally.

‡ Appear to refer to iii on either side.

§ An obvious error. The setæ of i and ii may be considered as being in the same line on each segment, but iii is single-haired on the abdominal segments, and has no other hair in line with it, so that here Poulton adds an extra tubercle and seta. A later note of Poulton's suggests that he may be here including the prespiracular (? v) as being in the same line as iii (see last footnote on p. 309).

and without definite arrangement.* Upon the thoracic segments the hairs are arranged so as to continue the four lines described above, but they are less numerous, at any rate in the case of the two upper rows, where there is only one hair to each row on each segment.† The head is thinly covered with similar hairs. . . . . The mandibles are green, with the cutting edges black. The ocelli are black and distinct. The spiracles are hard to make out, and the dorsal vessel is visible but not distinct. The head is rounded and of a generalised larval shape and not Sphinx-like. The horn is flexible and movable; it soon becomes straight, and may be held at an angle or parallel with the back. . . . The dorsal vessel becomes very distinct after the larva has fed for a short time, and the tracheal system is visible. The larva becomes greener, and the first trace of marking appears with the formation of a white circular patch round the base of each long hair in the four rows; the patches are especially distinct on the dorsal rows, and the larva, therefore, shows four spots on the back of each abdominal segment in front of the 8th, and two spots on the back of each thoracic segment. (Weismann describes and figures similar spots on the thoracic segments of *Smerinthus populi* in first stage.) These white patches are the first readily seen shagreen-dots‡; then minute white spots appear all over the body, which are the white areas round the bases of the smaller hairs §; then by a linear arrangement of the white spots (in which both large and small take part) the essential markings are established (see *loc. cit.*, pl. vii., fig. 2). The subdorsal becomes distinct before the oblique stripes, and the latter are rather faint during the whole of this stage. The white subdorsal is perfectly normal, extending the whole length of the body and bending gently upwards anteriorly in the 1st thoracic segment, and posteriorly into the base of the horn (being continuous with the 7th oblique stripe). The subdorsal may be seen to be formed of white dots, which are also present over the whole surface ‖ but are not conspicuous; so also with regard to the oblique stripes, but here there is an interesting relation to the larger spots. The anterior dorsal pair on each segment always forms part of the stripes, but the latter, converging posteriorly, fall within the hinder pair; so also the anterior spots ¶ only of the lateral rows on each segment fall into the oblique lines. There is a very minute and faint 8th stripe in front of the 1st oblique stripe on the 1st abdominal segment; it does not extend downwards far enough to meet the subdorsal. The effect of the series of large dorsal dots on the thoracic segments

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* This is not so; the setæ that are present are easily homologised.

† This might suggest that what Bacot considers (*suprà* p. 308) a possible abnormality in the specimen he described is really a normal condition, *i.e.*, the seta of ii on the meso- and metathorax is largely atrophied, but Chapman (who has specially examined mounted specimens) states that this is not so (see 1st footnote on p. 308).

‡ These pale patches are at the bases of the primary setæ and so can in no sense be described as shagreen-dots, which are connected with secondary hairs.

§ There are no smaller hairs in this instar.

‖ These white dots, if, indeed, any are present in this instar, are at most only showing through skin from beneath.

¶ Does Poulton here mean the prespiracular by "the anterior spots of the lateral rows?" As a matter of fact the lines go through iii as well as v (see *anteà* p. 307, line 41), so that either might from this standpoint be his "anterior" spots.

(two on each) is to produce the appearance of a very indistinct line above and parallel with the anterior part of the subdorsal; this line is also contributed to by the smaller dots.* As the small anterior oblique stripe does not reach the subdorsal, but stops at about the level of the hinder end of this indistinct line, there is an appearance of continuity between the anterior stripe and the line; this, however, does not really take place, as the former stripe is prolonged for a very slight distance below the posterior end of the horizontal line. These markings are very persistent in after stages, and are, therefore, described in detail.† The 1st stadium lasts about 6 or 7 days; at its close (before moulting) the larvæ are about 12mm. long when extended in walking pl. vii., fig. 2); the larva is about 10·5mm. long when rather retracted at rest, the horn 4mm. long (Poulton). *Second instar:* The larva is now covered with mammillated tubercles, precisely as in the Amorphid larvæ, each tubercle carrying a minute hair, some apparently only thickened a little at the end (seen edgewise?) others definitely bifid. The head in 1st stage carrying simple hairs on a smooth surface is now mammillated also, but has a rounded vertex (not produced into a horn as in *Smerinthus*). The true legs are slightly affected by the mammillation. The horn is relatively shorter than in stage 1, and the mammillæ fewer than the hairs in stage 1 (Chapman). The primary setæ still show conspicuously because of their larger size, but, in this skin, the secondary hairs, borne on mammillæ, are a well-marked and conspicuous feature; these secondary hairs appear to be short and stiff and slightly bifid at tip, whilst the bases are tall and conical (Bacot). The markings of this stage almost exactly resemble those of the last ‡ (see, *loc. cit.*, pl. vii., fig. 3), and the origin of the lines and stripes from linear series of shagreen-dots is equally § obvious. The large spots and long hairs have now disappeared ¶, except

* Not till the second instar unless by showing through the skin.

† This statement probably explains Poulton's faulty description of the larva in its 1st instar. He describes these markings in detail in stage 1, because "they are very persistent in the after stages." How could he have known when the larvæ were in stage 1 that the markings were going to be "very persistent in the later stages?" The fact is that almost the whole of the structure and markings, as here described, are those of stage 2, which Poulton has apparently carried back as a guess to stage 1. This is clearly evidenced by his statement (*Trans. Ent. Soc. Lond.*, 1885, p. 283) prefacing the description here given, in which he says, after referring to the primary setæ, which he calls the "long" hairs, "In addition to these long hairs, there must be a comparatively thick coating of much smaller ones. I was able to prove their existence at a later date by the use of the compound microscope, or even by a powerful hand lens, but I was away from home and without a sufficiency of appliances when the larvæ were in the 1st stage. There can be no doubt of their presence, and they cover the horn as well as the body." Not having seen them in stage 1, but being convinced they were there, and having become convinced later of their importance, he has evidently carried back his observations on these particular structures made in the later stages to stage 1, and dealt with them as if he had actually observed them in this stage, which is altogether misleading and unscientific, and the facts as applied to stage 1 unfortunately happen to be entirely erroneous.

‡ This must be read in connection with our last footnote, explaining that Poulton's markings of stage 2 were evidently written back into stage 1.

§ The formation of these is obvious in this (2nd) instar, there are no shagreen-dots in the 1st instar, so the origin of the lines from them then is not to be made out.

¶ We have no knowledge of Poulton's "large spots" which he has described as being at the base of the "long hairs," *i.e.*, primary setæ, unless they refer to the chitinised skin surrounding the bases of the primary setæ; but he is wrong in saying that the latter have disappeared in this instar, for they still show conspicuously, although less easily detected, now that they are surrounded by secondary shagreen-hairs.

those that enter into the 8th stripe and indistinct line above the subdorsal on the thoracic segments. This line is whiter than the other markings, which are yellowish-white (see, *loc. cit.*, pl. vii., fig. 8). Minute hairs still * terminate the shagreen-dots, whether arranged in lines or covering the surface of the body. (This fact is true of the dots whenever they appear in any stage.) The margins of the claspers, tips of true legs, and spiracles have a pinkish tinge. The horn is pink immediately after the change of skin, but it soon darkens and possesses a brownish-red ground-colour, covered with dark tubercles (shagreen-dots) pointing upwards and terminated by minute hairs; the apical pair is arranged so as to cause a bifid termination, but this is not nearly so distinct as in the last stage; on each side of the base the ground-colour of the horn is free from tubercles and hence appears as a brownish-red continuation of the 7th oblique stripe; the horn is movable, and is sometimes depressed, so as to become parallel with the line of the back, while at other times it is elevated to the usual position of an angle of 45°. (The same thing occurs in the first stage.) The head is shagreened and shows indications of its ultimate appearance in the occurrence of a white marginal line round the face. In this stage the oblique stripes are very distinct, and the subdorsal indistinct except anteriorly. The length of a fullgrown larva, comfortably stretched at rest, in this instar is about 18mm. This stage lasted about 9 days. *Third instar:* After the second ecdysis, the larvæ very much resemble those of the previous stage. The chief difference is in the subdorsal, which has disappeared, except anteriorly, and is indistinct even where it is retained. The horizontal stripe above the subdorsal is distinct, and so are the prominent white spots on the thoracic segments (one pair on each). This line has the same relation to the 8th stripe, but the continuity is only apparent, for careful observation shows that the latter extends below the posterior extremity of the former. (This is also true of the previous stages.) At this time, and in the second instar, the larva bears the closest resemblance to a Smerinthid larva in every respect, except the dark colour of the horn and the shape of the head. There is still a trace of the bifid termination to the horn (see, *loc. cit.*, pl. vii., fig. 10). Shortly after ecdysis the colours darken in certain parts; the pink horn becomes dark brown with black tubercles, as before, the effect being nearly black, except at the sides of the base. A black cloud appears on the side of the head and extends downwards behind the yellow line at the margin of the face; there is, however, much variability in this respect, some larvæ having no trace of black on the head. The spiracles are ochreous as in the adult, but more faintly. The true legs become red, and a dark purplish margin appears round the claspers. The anal flap has a white margin. The ground-colour is yellowish-green above, darker green below, and this latter extends upwards in front of the oblique stripes as a dark shading for one-third of their length, but the depth of colour is very variable. The shagreen-dots are yellowish-white, those forming the stripes being much larger and whiter than the others; at first, the component dots of the stripes are distinctly separate,

* Both the minute hairs and shagreen-dots (except on the caudal horn) first become structural features in this instar.

but, later, they enlarge and fuse, producing the appearance of a white band, upon which is a single row of tubercles, each emitting a minute hair. These tubercles are the original shagreen-dots, and each is placed in the centre of a white area, which has spread from the base of the former into the ground-colour. The areas form the white stripe, and they can be readily distinguished, as each is situated upon one of the secondary rings into which each segment is divided. The secondary annulation began in the first stage and is present throughout larval life. There are eight of these annuli on each of the segments that bear the oblique stripes, except the 8th abdominal. Where this latter segment is crossed by the upper part of the 7th stripe, entering the base of the horn, the annulation is not present and the adjacent areas are not separated by furrows (between the annuli on other segments), and, therefore, fuse at an early date. The 7th stripe is also much whiter and more conspicuous than the others. As the larva advances in this stage, the subdorsal and the stripe above it become indistinct, but the 8th stripe becomes more prominent and is especially well seen as a V when the larva is looked at from above. The head is shagreened as in previous stages*. The most interesting fact about this stage, however, is the appearance of the purple borders to the white stripes. These were never present at ecdysis, and, in some instances, they did not appear at all in this stage (in the case of very light varieties). So, also, the time at which they made their appearance varied greatly, and the extent to which they were developed. The stripes are linear and very narrow; they first appear as a brownish rather than purple edge to the central part of the 1st and 7th stripes. Then they appear in front of the others nearly at the same time and without any definite order. It seemed that the first stripe gained a border rather before the 7th. The purple edge is not a modification of the white stripe, but is distinctly due to a darkening of the ground-colour. So far from the shagreen-dots having any relation to the border, they are either absent from it or very small (which is also true of the ground-colour anterior to the whole length of the stripe). There is nothing spot-like in the first appearance of the border, it is always very narrow and linear. Its first appearance confirms the view that I expressed last year (*Trans. Ent. Soc. Lond.*, pt. 1, 1884), *i.e.*, that the border is a modification of the ground-colour in front of the white stripe, and is not due to the drawing out of patches of colour that appear in this position, in fact that the border is linear primarily and not secondarily. Kleemann states that the larvæ acquire the purple borders in the 4th stage, and Weismann says that he has observed the same thing. Nearly all my larvæ acquired the borders in the 3rd stage as above. At the conclusion of this stage the larva is about 25mm. long, when comfortably at rest. This stage only lasted about 6 days. A larva at the end of this stage, comfortably extended at rest, is shown at fig. 4 × 2. *Fourth instar:* The larva at the beginning of this stage is exactly similar to one in the last except for the greater size of the purple borders. The subdorsal and line above it are present at first, but subsequently disappear, while the 8th stripe remains. The pair of distinct dots are at first visible on each thoracic segment but they afterwards cease to be

* Should be "stage." The head is smooth in the 1st instar, shagreened in the 2nd.

recognisable, together with the line of which they form part. The 7th stripe is continuous, and so also are the central parts of the others where the purple border is present. The latter varies in amount and I have seen it almost absent except on the 1st and 7th stripes. Immediately after ecdysis the dots of the stripes are separate (fig. 9 × 4). The stripes are pure white where they are bordered with purple, but yellowish above this part, while the purple gives place to dark green. The purple and pure white change to the other colours before reaching the posterior limits of the segment they are crossing, while in the 5th stage the change takes place in the next segment, posteriorly. The white stripes are continued inferiorly and anteriorly into a very distinct row of white tubercles on the next segment, anteriorly (as in the adult). The ground-colour of the part of the surface on which the oblique stripes run (except the inferior continuations just mentioned) is a much brighter and yellower green than the rest of the body. The upper yellowish part of the oblique stripes is formed of distinct and separate yellow tubercles. This is the stage of the "Sphinx" attitude and the head is held higher and further back than at any other time. As the larva approaches the end of the stage it becomes very adult-looking, this effect being especially produced by the shagreen-dots becoming less conspicuous. There is great variation in the darkness of the larvæ, the dark forms having black sides to the head, while the purple borders deepen anteriorly and inferiorly into very nearly black. The lightest larvæ have hardly any black on the head, and the purple only deepens to brownish. There is every shade of difference between these extremes. A fullgrown larva in this stage is about 33mm. long in the "Sphinx" attitude, but much longer when extended (see fig. 5, rather over natural size). This stage lasts about 6 days. *Fifth instar:* At the beginning of this stage the larva is about 33mm. long when at rest in rather a contracted state after the effort of ecdysis. This is the last stage, and the larva is, of course, wellknown, nevertheless, there are some extremely interesting facts about it especially that concerning the change from a shagreened to a very smooth larva. Immediately after ecdysis the body is shagreened all over with minute dots which still terminate in hairs (see plate vii., fig. 6, natural size), and I formerly suggested (in paper already referred to) that the row of white dots continued anteriorly and inferiorly from the white stripes were the remnants of the shagreen-dots. This is now certain, for they have been traced through the ontogeny *, and, further, even in this stage, each one of them terminates in a minute hair, which is retained to the end. The shagreening very quickly disappears, but it can be detected with a powerful lens, and always remains visible (though very minute) upon the undersurface of the body. Although the horn is so smooth and shining in this stage, traces of the tubercles can still be made out. The 8th stripe is always present after ecdysis, but it quickly disappears. The deep black of the horn and sides of the head are replaced by dark green after ecdysis, but the latter darkens in a few hours. The shagreening seems to disappear by a change of colour into that of the surrounding ground-colour, and a gradual disappearance of the raised eminence which forms each dot. There is the same variability in darkness as shown

* It must not be forgotten that they are not present in the 1st instar.

by the different degrees of depth attained by the lower part of the purple border. When this becomes very dark some patches appear on the other (inferior) side of the white stripe. [I described this variety last year from a single instance found in the field, but it was quite common among the larvæ reared during the past summer.] The larvæ turned brown in many cases on August 21st, this stage having lasted about nine days. Thus, the whole larval life lasts about five weeks. There were many exceptions to the periods given for each stage (which were, as far as possible, average instances) (Poulton). *Adult larva:* Length from 3ins.—3·5ins. (according to position), the greatest width at 5th abdominal segment, just over ·5ins. Body cylindrical, tapering gradually forwards from the 3rd abdominal segment. The segmental incisions very clear and distinct, and there are 8 poorly-marked abdominal subsegments. Head forming a tall, curved-sided trapezoid, somewhat rounded at the crown and slighted notched, ·25ins. in height, and ·19ins. in breadth; the suture of lobes distinct, the clypeal triangle small; the surface somewhat rugose (but as though it had been smoothed over after being roughly granular), bright green in centre of face, but suffused with white towards margins, a broad black band up the sides of the face and over the crown; the antennæ stand out well, but are not large in proportion to the size of the larva. Thoracic segments, short and small, the skin much wrinkled, of a clearer and more pellucid green than the rest of the body (probably a tribal character); the scutellum on prothorax shows out distinctly owing to its being yellower in colour than the rest of the body, although it is far from distinct structurally. True legs small, black at base, then a broad white band and lastly black again for the terminal third. The abdomen smooth, bright, slightly yellowish, green above, a paler duller green on sides, shading off to glaucous-green ventrally; the secondary hairs and primary setæ can only be faintly discerned under a powerful lens; the spiracles large but not proportionally so to size of larva, of a dull golden colour, without a perceptible rim; the caudal horn, hard, stiff, curved and spiny, somewhat roughened, black in colour, except for a yellowish stripe up either side for about half its length; the oblique stripes slope upwards and backwards, they form broad, dull, crimson slashes, bordered by bright white ones of about equal size, tailing off below into 4 white spots; the last are well-marked shagreen-hairs with coloured bases; the double pigmentary character of these stripes is strongly accentuated, the junction of the two colours being very sharp, and so vivid are the colours that they give the impression of being painted on the skin-surface instead of being beneath it; the bright colours do not extend beyond the segment on which each stripe originates, *viz.*, 1st to 7th abdominals, but they are continued forwards on to the lower part of the next anterior segment by the white spots, and backwards above on the next following segment, by a clear shade of green, deeper in tint than the ground-colour, bordered by brighter yellow nearly as far as the centre of the dorsal area (Bacot. July 19th, 1901). Newport's account of the musculature of the larva of *Sphinx ligustri*, in his article "Insecta" (Todd's *Cyclopedia of Anatomy and Physiology*, 1839, pp. 853—994), is among the best that have yet been published. His diagram of the muscles and nerves

of the ventral surface of the segments in the larva of this species is reproduced by Packard (*Textbook of Entomology*, p. 212) and a brief summary of the musculature is given (*loc. cit.*, p. 213). Réaumur gave an excellent description and figure of the larva in 1736 (*Mémoires*, ii., pp. 253-256). Newman describes the larva (*Ent.*, iii., p. 34).

Larval moult.—The whole body is wrinkled and contracted in length, and there are occasional powerful contractions and twitchings of its entire body; the skin becomes dry and shrivelled, and is gradually separated from the new and very delicate one of the next instar beneath. After several powerful efforts of the larva, the old skin cracks along the middle of the dorsal surface of the mesothoracic segment, and, by repeated efforts, the fissure is extended into the 1st and 3rd thoracic segments whilst the covering of the head divides along the vertex and on each side of the clypeus. The larva then gradually presses itself through the opening, withdrawing first its head and thoracic legs, and subsequently the remainder of its body, slipping off the skin from behind like the finger of a glove. This process, after the skin has once been ruptured, seldom lasts more than a few minutes. When first changed the larva is exceedingly delicate, and its head, which does not increase in size until it again changes its skin, is very large in proportion to the rest of the body (Newport). Hellins observes that the larva always eats its cast skin.

Relation of the colour of the larva of Sphinx ligustri to those of its foodplants.—Poulton notes (*Trans. Ent. Soc. London*, 1886, p. 153) that he found two full-grown larvæ upon wild guelder-rose, that the ground-colour of the larvæ was bright green, like that of larvæ on privet, but the coloured borders to the stripes were of a very bluish-lilac and rather duller than those in larvæ found upon the latter plant. On August 1st, 1885, a larva found upon privet possessed the bright colours usually associated with this foodplant. Fed upon lilac during the last stadium (August 1st-12th), there was a gradually increasing change towards the duller colours which are always caused by lilac, which, however, were not ultimately produced to such an extent as is seen after feeding the larvæ upon this foodplant for their whole life. Sich notes (*Ent. Record*, xii., p. 53) that he saw, August 16th, 1899, what he thought was a curious thickening of the petiole of an ash-leaf, investigation proving that the swellings were the prolegs of a fine larva of *Sphinx ligustri*, which was otherwise hidden by the leaflets. It was excellently protected by its tint, which was of a greyer shade of green than the specimens one usually finds on privet.

Variation.—Besides the variation in ground-colour that appears to be due merely to a response to the tint of the particular foodplant on which the larva is feeding and already described, there is a marked aberration, which Buckler has excellently figured (*Larvae*, &c., ii., pl. xxii., fig. 2) of a bright reddish colour, the thoracic segments, ventral areas below spiracles, and anal area behind the last oblique stripe of a deeper, duller red tint, with white oblique stripes, preceded anteriorly by strong black fusiform margins, not at all similar to the usual purple margins. The white stripes become pale violet in their continuation over the dorsum, whilst the head, prothoracic plate, area at base of caudal horn posteriorly, and

spiracles are green. The segmental incisions are also green. From the letterpress *(loc. cit.*, p. 110) one learns that the larva was found in the grounds of Colchester workhouse on privet by Laver, on September 6th, 1882. It was with great pleasure that we received on October 22nd, 1902, two larvæ closely resembling this form from Mr. Head, of Scarborough, who wrote: "Most of my larvæ of *S. ligustri* were more or less of this colour this autumn, and I believe the cold weather is the cause of it. I have often had a few dark specimens when the larvæ have been late in feeding up." One of the larvæ received was already moribund, the other of a tint rather deeper dorsally than that of Buckler's figure, the upper part of the oblique lines pink instead of pale violet, the spiracles yellow instead of green, and the sides, in front of the lower portion of the oblique lines and the area below the subspiracular flange, black, the caudal horn very shiny black, the anal flap also black, the prothoracic plate and head blackish without the green markings shown in Buckler's figure; there is no green mark behind the caudal horn, and the prolegs and venter are of a deep purple-black, except that the pale mark on the outside of the prolegs is hardly distinguishable *(Ent. Rec.*, xiv., p. 343). Fitch notes *(Ent.*, xxxiv., p. 254) that, on August 10th, 1901, a fullfed larva, exactly like that figured in Buckler's *Larvae*, ii., pl. xxii., fig. 2, was found on a potato-patch at Goldhanger, near Maldon. He also mentions another larva that was more purple than green, but not so dark and distinct as the one here noted. Hellins says that the only minor variation that he has seen in the larvæ of this species has been in the size and the depth of colour of the slanting lateral stripes. Before pupating, the larva loses its normal green colour, and becomes a deep purplish-brown [("sad brown" (Hellins)]. This change of colour, which takes place at the time that the larva leaves the green foliage of its foodplant, to crawl over the ground to find a place for pupation, is most probably of protective significance. Schultz notes *(Illus. Zeits. für Ent.*, iii., p. 359) that he found, on August 19th, 1897, in the neighbourhood of Halensee, near Berlin, a larva of *S. ligustri* without a caudal horn, a dark chitinous plate raised only slightly above the surface of the body occupying the usual position of the horn. The larva pupated well and produced a ♀ imago the following May or June. Bacot writes (*in litt.*) that Shaw exhibited, at a recent meeting of the City of London Entomological Society, a larva with two caudal horns, the second being a small duplication of the first and arising behind it (? on the 9th abdominal segment).

Cocoon.—The larva goes down into the ground to a depth of about two inches and there makes a dome of beaten earth, about one inch high by two and a half inches long. Like the larva of *Hyles euphorbiae*, it makes no special floor in constructing its cocoon (Harrison); the larva goes down some distance into the soil and makes an earthen cocoon in which to pupate (Hellins). The larvæ appear to have more need than most of fresh earth in which to pupate, and the cocoons appear to be rarely lined much with silk. Sometimes the silk is altogether insufficient to hold together the grains of dry earth, so that it is necessary for the earth to be sufficiently damp for the walls of the cavity they form to support themselves; the larva appears only to take care to beat and press well the walls of the cavity where the pupa will remain (Réaumur). The larvæ go into

the earth to a depth of about 3 inches, and there make a cell of fine mould, about 1·25 inches high by 2·75 inches in length, and pupate therein (Clarke). The cocoon is very fragile, and is always placed beneath the surface of the ground (Ransom).

THE PUPAL ECDYSIS.—The larva lies 8 or 10 days in its earthen cell, and gets very shabby and dirty-looking, from the shrivelling and darkening of the effete larval skin. Immediately on moulting, the pupa measured 1·87in. in length, made up of (1) ·63in., from anterior extremity to end of wings; (2) 1·24ins., to posterior extremity. The segments are all very marked and rounded, with deep incisions, the terminal is full and blunt, not tapering as in the mature pupa, the 5th and 6th abdominal segments being especially large and globular. The head stands out and somewhat apart, as it does permanently in many Tineid pupæ. The proboscis-case forms a square projection ·1in. in length and width, but bent down somewhat already, markedly bifid, and the two lateral halves easily separated. This case assumed its permanent shape and length of about ·28in. in about an hour. Before moulting, the relative size of the segments had much changed, the prothorax being large (from head pushed back into it?) the first abdominal very small, etc. The margin of the mesothorax against the 1st spiracle was already brownish, as well as the flanges on the 5th, 6th and 7th abdominal segments. After two hours the relative lengths of measurement given above—(1)=·63, (2)=1·24, had become—(1) =1·1, (2)=0·78. The abdominal spiracles were widely open, and the winking movement of a membranous fold from the posterior wall of the trachea a short distance within, was easily seen. There are, in this species, no dark chitinous parts in connection with these valves. These movements continued as long as observation could be made. The period of closure became longer and longer. The movements of the valves were synchronous with the vermicular movements, but not with the pulsations of the dorsal vessel. During actual moulting the valves were quite closed. As well as the chitinous dark margin to first spiracle, the abdominal flanges and the anal spine, there was also a slight chitinous tinting of the dorsum of the mesothorax. The lateral stripes of the larva were again very bright, and there are reddish spots (non-chitinous) at the sites of the prolegs. The 8th abdominal spiracle yields as strong a tracheal lining as the others, yet seems to be quite closed and obsolete, as soon as this is withdrawn. The spiracles of the 6th and 7th abdominal segments are closed in about 15 minutes, those anterior rather later, that on the 2nd abdominal segment in about 20 minutes (Chapman). The newly-turned pupa is of a rich green colour (Hellins). The changes that take place both externally and internally in the larva of *Sphinx ligustri* during pupation were worked out at length by Newport in his article "Insecta" (in Todd's *Cyclopedia of Anatomy and Physiology*, 1839, pp. 853-994). The figures are reproduced by Packard (*Textbook of Entomology*, p. 646) and exhibit the arrangement of organs in the fullgrown larva, the pupa, and the imago, in such a manner that comparison is easy.

PUPA.—Of ordinary dark brown chitinous colour; length of a ♂ pupa 41mm., of a ♀ pupa 46mm., but may vary much from these dimensions. It is a fairly straight pupa, *i.e.*, no evidence of any curve dorsally or ventrally at any part. The anterior extremity of the

pupa is some 2·5mm. to the ventral side of the apparent axis of the pupa, the mesothoracic dorsum and the two wing-bases are rather prominent, and there is a hollow where the 1st abdominal segment dips under the hindwings, otherwise the form is fairly circular at all points, but with just so much flattening under and beyond the trunk-horn, that it looks as if a true cylinder would just enclose the horn instead of exposing it. The measurements taken of a fair-sized ♀ pupa are:

MEASUREMENTS AT	LENGTH FROM ANTERIOR EXTREMITY.	ANTERO-POSTERIOR DIAMETER.		TRANSVERSE DIAMETER.
		(including proboscis)	(without proboscis)	
Posterior border prothorax, 1st spiracle	3·3mm.	11·0mm.	9·3mm.	8·0mm.
Wing-base, summit of mesothorax ..	8·0 ,,	12·6 ,,	11·0 ,,	12·3 ,,
Posterior border metathorax	12·5 ,,	11·5mm.		11·8 ,,
Front of 2nd abdominal segment, end of antenna and 1st legs	16·0 ,,	12·6 ,,		12·2 ,,
Front of 4th abdominal segment, end of 2nd legs	21·0 ,,	13·0 ,,		12·6 ,,
End of wings, posterior border of 4th abdominal	26·0 ,,	13·5 ,,		13·3 ,,
Front of 6th abdominal	31·0 ,,	12·4 ,,		12·5 ,,
Front of 7th abdominal	34·5 ,,	12·0 ,,		11·5 ,,
Front of 8th abdominal	37·5 ,,	10·0 ,,		9·6 ,,
Front of 9th abdominal	40·0 ,,	8·5 ,,		9·0 ,,
Front of 10th abdominal segment ..	42·0 ,,	4·0 ,,		4·0 ,,
Base of anal spine	43·0 ,,	1·5 ,,		2·0 ,,
Extreme length =	46·0 ,,			

The horn from labrum to extremity is 8mm.—7·0mm. in a small pupa; it is about 2mm. in diameter, a little less basally, where a space exists between it and pupa, a little more at end where it touches pupa. The pupa is thoroughly "Sphingid" in having the labrum well in front, it is almost, but not quite, the most anterior portion of the pupa. The convexity of the eye-lines is directed about 30° less than directly forwards, *i.e.*, 60° forwards of ventral. The labrum is not always clearly marked out, when it is, it is of pentagonal form, with a flat side to the maxillæ and an angle dorsal, and it carries a pair of tubercular elevations. The rest of the head is finely wrinkled rather than tuberculated. The glazed eye is a well-marked depressed curved line, with a narrow band outside it and a broader within, smoother than the rest of the head but with radial wrinkles, the outer passing into the general surface, but the inner well marked off by a definite curved groove from a central area of ordinary surface. The antennæ show the segments very plainly, about 65 can be easily counted; each segment has a central elevation and a lower one on either side, basally, where they are largest, these are further elaborated and subdivided and along the dorsal margin is a further row of chainlike wrinkling. The first leg is broad and touches both eye and antenna, and is marked with fine sharp transverse ridges, but markedly flattened down along the tarsal portion. Between this and the maxillæ is a very narrow smooth area about 3·5mm. to 4·0mm. long (the 1st femur?). The second legs are comparatively very narrow, with similar (transverse anastomosing) ridges to those on first. The maxillæ extend to

end of wings and are similarly ridged, the dimensions of horn have already been given. It arises from a triangular area, similar to that seen in many pupæ where the bases of the maxillæ extend up between the cheeks, below it the maxillæ extend laterally beneath the cheeks almost to the glazed eyes. Apart from the maxillary horn, which is no larger at its base than elsewhere, the maxillæ have quite an ordinary level aspect, no trace of keeling as in Eumorphids. The prothorax is finely but roughly wrinkled in a labyrinthine manner. The mesothorax has the wrinkles larger and smoother, running transversely but with breaks and anastomoses. In some individuals there is a very definite suture down the dorsal line of the pro- and metathorax, looking as if it must be functional; in a majority of pupæ this suture is easily seen, but looks more or less obsolete, in a few it is almost absent. In one specimen, for instance, there is no trace of it on prothorax, but it is fairly indicated on anterior half of mesothorax. It is not uncommon for a similar suture-like depressed line to occur on the dorsum of the 4th and 5th abdominal segments, with traces of it on others. There is a sort of central point in the wrinkling about two-thirds from the anterior margin of the mesothorax. The wing-base is marked off by a smooth suture-like line, beginning in a few (three or four) longitudinal wrinkles a little nearer dorsum than antenna; over the wing-base the wrinkles are marked out into small definite regions, which may indicate patagia or parts of the details of the wing articulation. Where the wing nervures start is very prominent and marked by a few small tubercles, or separated points of the wrinkling. The wings have transverse wrinklings well marked basally, but, smoothing out, ill-defined and irregular towards the hind margin. Eight nervures are obvious as raised above the general surface, any others are lost in the costal thickening. Poulton's line is a fine impressed line beyond which there is fine uniform wrinkling, the breadth being about 0·6mm. The costal thickening is really the raising of the wing-surface by the 3rd pair of legs underneath, at least very largely, in some specimens they reach almost to hind margin, in others a drop in the wing-surface shows they fall short, sometimes by a couple of millimeters. The prothoracic spiracle is a narrow slit with rather dark margins. The metathorax is a much reduced piece, 10mm. across, about 1·2 mm. long dorsally, and 2·0mm. near its margin, with the hindwing, marked off by a suture, extending down from it as a very narrow slip, 0·3 mm. wide, opposite spiracle of 2nd abdominal and 0·7mm. opposite next incision and terminating opposite the 3rd abdominal spiracle. Poulton's line is fairly indicated along this inner margin of hindwing. The surface of the metathorax shows a dorsal raised ridge and two, transverse, raised ridges extending out from this for about 2·0mm. (the callosities of *Manduca*, many Sphinges etc.) Laterally the intersegmental subsegment is well seen, the rest of the segment has the usual wrinkles (transverse). The sculpturing of the abdominal segments is as usual difficult to describe. It is not easy to say whether it should be called wrinkling or pitting. On the 8th, and probably the 7th, it may be called pitting without much error. This becomes gradually modified into wrinkling as one progresses to the anterior segments. Of each segment, however, the basal portion is that whose sculpture is

rather pitting than wrinkling. As to subsegmentation, the intersegmental subsegment is broadest and plainest laterally, it is very narrow dorsally, laterally it is much smoother than the rest of the segment. Other subsegmentation is only clearly visible, dorsally, and varies in distinctness in different pupæ. There is an anterior subsegment, rather the broadest, and then two of about equal width, and behind this there is sometimes an indication of another besides the intersegmental one. On the 4th, 5th and 6th abdominal segments, immediately in front of the spiracle and extending from it dorsally (about 5mm.), is a sharp ridge, with a smooth surface in front of it, which is terminated by another straight line close to the edge of the segment. The scar of prolegs (on 5th and 6th) is always present, but varies much in its character—it may be a smoother area with radiating wrinkles, it may present stronger concentric wrinkles, usually it is somewhat depressed. It may be slightly raised with a central foveola and strong wrinkles around. The scar of horn on the 8th abdominal segment is usually a small, definite, smooth tubercle, or it may be a larger but less definite elevation. There is always a hollow behind it (impress of bent larval horn when awaiting pupation). The anal spike is strongly wrinkled and does not taper much for first $\frac{2}{3}$rds of its length; here are two latero-dorsal spines, more or less distinct; beyond this it is smoother, tapers rapidly and ends in a double spine. In the ♂ pupa, the tubercles are very marked, symmetrical, and are on the posterior border of the segment, usually projecting behind it and leaving $\frac{2}{3}$ths of the segment in front of them unoccupied, this space, however, is smooth, and there is a tendency to smooth out the incision in front up to the 8th segment. These tubercles vary a little, each, usually, has a smooth reniform area lateral to and behind it, and they may be a little irregular as to symmetry. The female tubercles are almost exactly like those of the ♂ in size and prominence in some instances, in most they are flattened down and almost obsolete, the central pore is always indicated as a longitudinal impressed line, the 9th segment is prolonged up to this point, indeed, the 10th appears to be, the incisions bending forwards and becoming obsolete. No posterior pore is indicated. In both sexes the anal scar is a longitudinal groove, with lateral ridges or wrinkles filling up an oval area, 2mm. long, 1·6mm. across. The general form of the posterior extremity of the pupa is indicated by the measurements given. It tapers with some regularity till a diameter of about 4mm. is reached, and then the pupa ends abruptly, except that on the dorsal margin the anal spike arises. In a few specimens, the anal area, usually terminal, is more ventral, and then the tapering is more gradual. The spiracles are slits nearly 1mm. long in darker depressed oval areas, with fine raised margins, and with one or more intermediate lines between the spiracle and the margin. Viewed microscopically, the first spiracle has no fringed or spiculated margin. The prothorax has a good many minute hairs, the mesothorax only one or two, whilst the metathorax has four very definitely placed, as though they were the ordinary tubercles. On the abdominal segments these hairs are most abundant near the spiracles, elsewhere very scarce. The prespiracular flange has a 1st dark ridge above spiracle, then a second nearly as strong, the area between

them is smooth and free from any sculpture—pits, hairs, &c. The area between the second and the anterior margin of the segment has no sculpture, but a good many minute hairs. The pits have a peculiar "fish-scale" aspect, margin crenate with radiating shading to the crenations from a central point. Neither the pits, the hairs, nor the wrinkling present any very definite connection with each other nor any intergrading appearances. The callosity of metathorax consists of a few labyrinthine walls standing up darker, of which two are especially strong and dark (Chapman). Poulton figures and describes (*Ext. Morph. Lep. Pupa*, p. 205, pl. xx., figs. 20-21) the terminal abdominal segments of a ♂ pupa of this species. Fig. 20 (× 4) represents the 9th and 10th abdominal segments seen from the ventral aspect, showing the sculpture of the surface and the ♂ reproductive organ. The latter is typical; its relation to the boundary between the 9th and 10th abdominal segments is better shown in the next figure (21), where it is seen to be nearly the same as in *Manduca atropos* (fig. 17). Fig. 21 (× 26) exhibits the median ventral area of the 9th and adjacent parts of the 8th and 10th abdominal segments, showing the ♂ organ and the surface sculpture very distinctly; the lateral tubercles are more closely applied than in *Manduca atropos.* The pit in front of the reproductive organ is merely an individual peculiarity. Jackson gives other figures (*Studies Morph. Lep.*, pl. xv., figs. 11-14) showing details of the pupa of this species. Fig. 11 is a ventral view of the abdominal segments 8-10 of a ♂ pupa. The punctuations of the chitinous cuticle are indicated in the 8th and 9th segments; ♂—indicates the aperture of the ductus ejaculatorius and its two triangular lips; *r. p.*—are the prominences representing the anal prolegs. Fig. 12 is a similar view to fig. 11, but the pupa is a ♀. The mark ♀ in the fig. indicates the confluent ♀ apertures. Fig. 13 represents the enlarged view of the two ♀ apertures in an abnormal specimen; 8, 9 indicate the segments. It will be observed that the two apertures belong, as in the pupa of *Pieris brassicae* (fig. 2), to consecutive segments. Fig. 14 is a lateral view of the four terminal segments of the abdomen. The 7th (perfect) and the 8th (abortive) abdominal spiracles are shown. Corbin notes (*Zool.*, p. 3438) a pupa, found at Ringwood, with the sheath of the tongue distinctly bifurcate (cf., *anteà* p. 318).

Duration of the pupal stage.—The pupal period generally lasts some nine months from September-October to June-July (Montgomery gives it as 286 days in some that he had under observation), and we have only one certain record of an imago emerging in the autumn from a pupa of the year, although Bartel says that the imago is disclosed rarely in July and August of the same year; the record that we have is by Grote, who notes (*Illus. Zeits. für Ent.*, iii., p. 360) that he had a larva pupate in July, 1898, at Hildesheim, and that an imago emerged from the pupa at the commencement of September of the same year; a record by Daws of a ♂ captured October 3rd, 1900, at Mansfield, may also have been a representative of a partial second brood; we have, however, several instances of the pupal stage being extended beyond the normal period, *e.g.*, imago emerged on August 22nd, 1899, from pupa of September, 1898, all the remainder (kept under same conditions) having emerged in June, 1899 (Phillips); larva pupated September,

1881, produced an imago April, 1883, at Bournemouth, the pupa kept in ferncase and subjected the whole time to an unusually high temperature (McRae); 14 larvæ pupated in 1887, from which, in 1888, 8 imagines came out at the usual time, whilst the other six emerged in June, 1889, at St. Anne's-on-Sea (Baxter); another larva, from Bournemouth, pupated August, 1893, produced an imago June 5th, 1895, at Kingston-on-Thames (Gloyns); larvæ from Chagford, August, 1897, pupated and gave imagines on May 15th, 19th and 24th, 1899 (Studd), larvæ pupated September, 1880, produced two imagines, July, 1883, at Wanstead, the bulk appeared in 1881, the pupæ kept throughout in an outhouse (Argent, *Ent.*, xvi., p. 234); Freeman writes that he had a living pupa that had passed through two winters, had been forced twice without result and was going through a third winter. Verloren states (*Alg. Konst- en Letterbode*, 1847, pt. 2, pp. 147-148) that, of 29 pupæ which went through the severe winter of 1844-5, only 20 imagines emerged in 1845, whilst 7 came out in 1846, together with 30 from larvæ which had pupated in August—September, 1845. Haworth notes that this species has been known to remain two, or even three, seasons in the pupal state and then emerge well. Briggs quotes the strange statement that pupæ on the surface come out the first year, those deeper the second year, those deepest of all the third year. We have never seen the slightest evidence to bear this out.

Foodplants.—*Ligustrum*, *Syringa*, *Fraxinus*, *Lonicera*, *Sambucus*, *Salix* (Linné), lilac, holly (Albin), prefers variegated forms of holly, ash (Dell), *Laurustinus*, *Phillyrea* (Hellins), *Hortensia*, *Ligustrum vulgare*, *Syringa persica* (Speyer), *Sorbus aucuparia*, *Viburnum opulus*, *Spiraea salicifolia* (Moeschler), *Symphoricarpus racemosus* (Rössler), especially *Spiraea* (Fischer), prefers lilac (Hering), *Syringa vulgaris*, *Viburnum laurustinus*, *V. lantana*, *V. opulus*, *Nerium oleander*, *Ilex aquifolium*, *Celtis australis*, *Symphoricarpus parviflora*, *Daphne laureola* (Guenée), *Spiraea filipendula*, *Ornus europaea*, *Spiraea ulmaria* (*Filipendula ulmaria*), *Sambucus nigra*, *Lonicera caprifolium*, *L. xylosteum*, *Dipsacus fullonum*, *Carpinus betulus* (Bartel), *Viburnum tinus* (Dewick), *Cytisus purpureus* (Frey), sycamore (Harding), aspen (Brown), guelder rose, evergreen oak (Mathew), larva on wild teasel but left it for privet in confinement (Clogg), commonly on apple and pear in 1863 (Clifford, *Zool.*, 8906), hop (*teste* Dewick, *Ent. Wk. Int.*, ix., p. 20), larvæ found on *Viburnum tinus*, *Lonicera tatarica*, *Phillyrea angustifolium* and *Ilex aquifolium*, but none on *Ligustrum* although the latter was abundant in the district searched (Gower), larvæ on privet in 1897, but in 1898 appeared to be confined to ash at Salford Priors (Fountain), snowball tree (Perkins), Spanish lilac (Homeyer), *Euonymus europaeus* (Bond), laurel (Luff), Portugal laurel (Wilson), *Cornus sanguinea*, *Laurustinus* (Crewe), willow preferred to privet (Braine, *Ent.*, iv., pp. 322-323), larva on rose and on the common blue passion flower (Daws), fuchsia (*teste* Lucas), freely on plum and oak (Finch).

Parasites.—*Ichneumon pisorius*, Linn. (Ratzeburg); *Ichneumon insidiosus*, Gr. (Rudow); *Pimpla examinator*, Gr. (Rudow); *Trogus alboguttatus*, G. (Adkin. This species is figured in *Proceedings Sth. Lond. Ent. Soc.*, 1886, pl. i., fig. 7); *Trogus exaltatorius*, Panzer [Bignell, bred July 4th, 1882. This species pupates within the pupa of *S. ligustri*

and after the parasite emerges the pupa appears to be half filled with thick creamy-looking matter, but there is no indication of a parasitic pupa-case (see *Ent.*, xi., p. 274)]; *Anomalon circumflexum*, Linn. (Rondani); *Exorista vulgaris*, Fallén (Bridgman).

Habits.—Merrifield states that the imagines emerge from pupa at almost any time throughout the day, but Russell observes that they emerge in the evening before 8 o'clock. The imago flies at dusk and continues on the wing far into the night. By crouching by the side of a tall privet-bush in early July, we have seen the females against the sky as they have come to lay their eggs, the noise made by the vibration of the wings being quite audible. Waters records (*Ent.*, xix., pp. 44-45) that, in 1885, he disturbed a ♀ whilst ovipositing, that it wheeled round repeatedly above his head, remaining poised each time over the spot whence she was disturbed for several seconds, the rapid vibration of her wings producing a loud humming noise distinctly audible, that became shriller after a time as if it were aware of his presence. Trimen has seen the imagines at flowers of rhododendron at Box Hill, about half-an-hour after sunset, looking like a yellow shade among the topmost flowers, hovering about the congregated blossom, etc. Lambillion, too, notes that they fly about 9 o'clock in the evening round bushes of *Ligustrum* in Belgium, and Montgomery has observed them flying at sunset over a mixed hedge at the foot of the downs at Eastbourne. Prideaux has noticed them at dusk hovering over privet blossom in the Isle of Wight, and over honeysuckle at Bristol, whilst other flowers noted are honeysuckle at Leytonstone (Meldola), at Boxworth (Thornhill), at St. Ives (Norris), at Chiswick (Sich), at honeysuckle and rhododendron at Newbury (Beales), at rhododendron in the New Forest (Richardson), in Upper Lusatia (Moeschler), at *Saponaria* in Modena (Fiori), at jessamine at Holloway (James), at *Nicotiana affinis* at Mansfield (Daws), at red valerian at Farningham (Barraud), at pinks at Groombridge (Blaber), whilst Caradja observes that the insect, usually rare in Roumania, swarmed at petunias in the hot summer of 1892. D'Urban notes an imago with a pollen-mass attached to right eye; and one is recorded (*Zool.*) as being caught by the tongue by a flower of *Œnothera speciosa*, at Sudbury, in 1848. It is often attracted to light and has been recorded thus—from Chester (Arkle), Winchester (Shepheard-Walwyn), Emsworth (Christy), Horrabridge (Still), Wicken (James), as well as at Bristol (Bartlett), at Oxton (Studd), at Boscombe (Robertson), and at electric light at Kingston-on-Thames (Cooper), at Taunton (Farrant), at Eastbourne (Dewey), at Ipswich (Morley), at High Wycombe (Peachell), at Berne (Benteli), at Zürich (Nägeli), at Aix-les-Bains (Agassiz), etc. It rests by day with its wings drawn over the body and is usually found at rest on posts, fences, palings, etc., the colour of which its forewings match admirably, but it is also taken occasionally on the trunks of ash, lilac and other trees. Martineau records (*Ent.*, xxvi., p. 231; *E.M.M.*, xxix., p. 170) that, at Solihull, a specimen of *S. ligustri* entered a beehive, and was killed by the bees who covered the body with wax. The species hardly seems to be so sedentary as one would think, for Cordeaux notes (*E.M.M.*, xxv., p. 111) that three specimens visited the Leman and Ower Light vessel, moored in the North Sea about 48 miles E.N.E. of Cromer,

on July 30th, 1888, at 9 a.m. (? p.m.), one was captured, whilst the others left the ship and went away with the wind. One feels, however, that one would like to have seen the captured specimen to make sure that it was not *Agrius convolvuli*. As to the power of the ♀ to attract the ♂s, Robinson notes that, at St. Leonards, in June, 1877, a ♀ was resting on the inside of a window when it was accidentally killed, yet between 11 p.m. and 3 a.m. 10 ♂s were captured in the room, and 2 on the glass outside this window. Weniger notes that, one spring, several specimens emerged between February 17th and 19th, among them a ♀. They refused to pair, but lived a long time, and, on March 22nd, a ♂ *Antheraea cecropia* paired with the ♀ *S. ligustri*. The ♀ laid part of her eggs the day after the pairing and then died, but the eggs all proved to be infertile. The pairing lasted 11½ hours.

Habitat.—This species is abundant in most suitable localities in the southern and midland counties of Great Britain, becoming rare in the north and west and being almost entirely absent from Scotland and Ireland. In the south of England its most frequent habitats are privet hedges in gardens and lanes, and bushes growing on the outskirts of shaws, thickets and woods, but holly hedges and holly bushes in similar situations are frequently chosen.

Time of appearance.—The imago appears from mid-May to the end of July. On the continent there appears to be in some districts a partial second-brood, *e.g.*, Roumania, end of June and September, imagines taken September 19th, 1892, in a garden in Roumania (Caradja), June and September at Deux-Sèvres (Maillard), Tuscany, rare in July and August, fullgrown larvæ found at the end of June (Mann). Daws caught a ♂ at flowers of *Nicotiana affinis* on October 3rd, 1900, at Mansfield, very possibly a second-brood example, as the captures in the same place are noted as May 15th, 1897 and June 12th-July 6th, 1898. Generally, however, the time of appearance on the continent agrees with that in the British Islands—end of April to July at Fünfkirchen; May at Wernigerode; May and June at Eutin, Brunswick, Halle, Dresden, Thuringia, Carlsruhe, Frankfort-on-Main, Alsace, Switzerland, Upper Austria, Eperies, Haute-Garonne, Loire-Inférieure and Sarepta; May to mid-July at Budapest; end of May to commencement of August at Leipzig; June at Lyngör, Bremen, Crefeld, Wiesbaden, Mülhausen, Zürich, Hermannstadt, Paris dist., Nantes; June-July in the Netherlands, Berne, and Hildesheim; July at Gorki; July and August at Aix-les-Bains, &c. Fritsch gives dates for Austro-Hungary from May 16th-July 3rd, also at Salzburg on July 17th and August 5th, common from July 9th, 1893, at Berne (Hiltbold), July 3rd-4th, 1898, at light at Aigle (Lowe). Hellins notes imagines from May 30th to July 14th, and one captured July 20th nr. Exeter. The following dates will give some idea of its time of appearance in various parts of the British Isles: May 27th-July 19th, abundant at Rochester and Chatham (Chaney), imagines in June at Southampton and Winchester (Moberly), ♂ caught May 20th, 1844, ♂ bred June 14th, 2 ♂s and 5 ♀s on June 16th, ♀ June 18th, ♀ June 19th, 1845, ♂ and ♀ May 29th, 2 ♂s and 2 ♀s on May 31st, ♂ June 1st, 2 ♂s June 2nd, 1846, June 1st, 1847, imagines emerged May 27th-June 21st, 1848, June 12th, 1850, at Brighton (Merrifield), June

27th, 1856 at East Looe (Horton), May 26th, 1857, and following days, at Faversham (Stowell), June 18th, 1857, at Wandsworth (Blackmore), June 20th, 1857, at Box Hill, July 15th, 1857, bred from Shanklin larvæ (Trimen), July 3rd, 1857, at Chelsea (A. H. Clarke), June 5th, 1858, at Barnstaple (Mathew), common in 1859, at Hull (Young), common June 13th, 1859, at Deal (Harding), April 9th-15th, 1860, bred at Worcester (Edmunds), July 18th, 1860, in a London square, July 10th, 1864, at Thurning, June 13th, 1866, at Tilgate Forest, bred July 2nd-15th, 1898, from larvæ found at Lynmouth, on September 22nd, 1897, others bred on July 5th, 1899, and June 16th, 1900 (T. H. Briggs), June 7th, 1866, at Northleach (Todd), June 5th-26th, 1869, in the New Forest (Capper); bred June 19th-23rd, 1870, June 10th, 1894, June 26th, 1898, caught June 20th, 1894, June 22nd, 1898, June 23rd, 1900, at Oxton, bred May 15th-24th, 1899, three, from larvæ taken at Chagford in August, 1897, others on June 20th, 1874, June 22nd, July 15th, 1898, at Oxton (Studd), June 18th, 1871, at Wanstead, July 7th, 1886, May 23rd, 1893, at Rainham (Burrows), June 23rd, 1871, at Eltham (Jones), imago July 17th, 1872, at Darenth (Bower), May 16th, 1873, at Bentley (Harwood), May 27th, 1875, at Llantrissant (John), June 1st, 1877, at Mapledurham, nr. Reading, June 7th, 1880, June 3rd, 1887, at Reading (Holland), June 14th, 1879, at Rugby (Wilson), June 14th-26th, 1880, at Wicken (Porritt), July 10th, 1880, at Earl Shilton (Storer), June 29th, 1881, at Hackney, June 5th, 1882, at Yarmouth, June 24th, 1894, at Sidcup and Eltham (J. A. Clark), June 24th, 1885, at Painswick (Watkins), June 7th-12th, 1886 at Brentwood, July 12th, 1897, at Woodham Mortimer (Raynor), 14 larvæ pupated in 1887, from these 8 came out in June, 1888, and six in June, 1889, all being kept under the same conditions (Baxter), June 14th, July 31st, 1888, at Bristol (Bartlett), commencement of July, 1888, at Groombridge (Blaber), July 22nd, 1888, at Holloway (James), ♀ emerged May 20th, 1890, from pupa found at Sandown (Montgomery), June 8th, 1891, at Lincoln (Musham), June 26th, 1891, June 18th, 1892, at Bristol, June 24th, 1895, in the Isle of Wight (Prideaux), June 1st, 1892, at Cheltenham (Sanders), June 1st-10th, 1892, at Shorncliffe, June 1st-14th, 1895, at Enniskillen (Brown), imagines June 20th, 1892, at Wicken Fen, June 29th, 1897, at Whitwell, June 30th, 1897, at Aylsham (Freeman), larvæ on September 12th, 1892, from which 1 ♂ and 2 ♀ s emerged May 11th-27th, 1893, from larvæ found August 6th-15th, 1896, imagines emerged May 29th-June 22nd, 1897, imago captured at Eastbourne on June 21st, 1897 (Montgomery), May 1st, 1893, at Emsworth (Christy), May 7th, 1893, and following days at Newbury (Beales), May 20th-22nd, 1893, in New Forest (Richardson), June 15th, 1893, at Penrith (Hope), June 30th, 1893, at Brandon Wood (Peachell), July 11th, 1894, at Southend (Whittle), June 6th, 1895, June 22nd-23rd, 1895, June 11th, 1896, at Winchester (Broome), June 20th, 1895, from larva obtained September 12th, 1894, at Guildford (Grover), June 3rd-16th, 1896, June 8th, 1897, June 5th, 1899, June 20th, 1900, at Worcester (Rea), bred imagines on June 6th-12th, 1896, at Wisbech (Glenny), June 8th, 1896, from larvæ that pupated August 29th, 1895, from Southbourne (Bingham-Newland), captured at Ashton Wold on June 22nd, 1896, bred on July 2nd, 1898, from larva found at

Croydon, bred on July 3rd-20th, 1898, from larva found at Folkestone, also on June 22nd and 25th, 1899, from larvæ at Sandown, captured at Torquay on July 24th, 1899 (Prout), imagines captured July 3rd, 1896, June 23rd-24th, July 21st, 1897, June 17th, 30th, July 2nd, 1898, at Chelmsford (Miller), July 25th, 1896, May 23rd, 1897, at Bristol (Bartlett), bred March 21st-April 1st, 1897, captured July 19th, 1897, at Boxworth (Thornhill), May 15th, 1897, June 12th-July 6th, 1898, October 3rd, 1900, at Mansfield (Daws), June 10th, 1897, bred from larva found at Hitchin, June 15th, 1901, at Bushey Heath (Barraud), June 13th, July 17th, August 8th, 1897, June 24th-27th, July 4th, 1898, June 11th, 12th and 16th, 1899, at Dawlish (Rogers), imagines emerged June 16th-22nd, 1897, from larvæ taken at Fleet, from August 31st-September 3rd, 1896, also imagines June 17th-23rd, 1898, from larvæ taken September 1st-4th, 1897, and on June 24th, 1898, from Southend larvæ found on September 19th, 1897, June 10th, 1897, from larva taken at Fleet, on August 8th, 1898, June 13th-21st, 1899, from larvæ taken at Otford, on September 11th, 1898 (Russell), July 11th, 1897, July 6th, 1898, July 7th, 1900, at Reading (Butler), June 7th, 1898, from an Enfield pupa (Edelsten), June 15th, 1898, at Hayling Island (May), imago emerged at Taunton, June 18th, 1898 (Tetley), June 21st, 1898, at Cheriton (Hill), June 25th, July 25th, 1898, at light, on Wicken Fen (James), June 28th, 1898, at Marathon, near Douglas (Clarke), July 9th, 1898, at Leicester (Dixon), ♀ at light, July 15th, 1898, at Chester (Dobie), larvæ found at Tavistock pupated September, 1898, all but one produced imagines June, 1899, this exception emerged August 22nd, 1899 (Phillips), imagines bred June, 1899, from larvæ obtained from Northallerton (*teste* Elgee), July 11th, 1899, at Chingford (McIntyre), captured July 14th, 1899, at Weymouth, others bred from forced pupæ from March 11th, 1900 (Peachell), bred June 4th-July 3rd, 1900, July 17th, 1901, also imagines emerged June 7th, 1902, and following days, at Dorking (Oldaker), bred June 7th, 1900, from larvæ taken at Malvern (Sich), June 9th-14th, 1900, at Farningham (Barraud), imago May 20th, 1901, at Esher (Fleet), June 6th, 1901, at Mucking (Burrows), imago June 28th, 1901, at Stanstead Abbot (Image), end of June, 1901, at Devizes (Sladen).

LOCALITIES.—Common in the south of England, rare in the north, very rare in Scotland and scarcely recorded for Ireland. ANTRIM: Ballymena (*teste* Bristow). AYRSHIRE: near Kilmarnock (Dunlop). BEDFORD: Bedford (Steuart). BERKS: West Woodhay, Newbury (Beales), Reading (Butler), Mapledurham, Pangbourne, Tilehurst (Holland). BUCKS: Buckingham, not uncommon (Slade), High Wycombe (Peachell), Foscott (Bland), Marlow (A. H. Clarke), Halton, common, Wavendon, near Newport Pagnel (Stainton). CAMBRIDGE: Fen district, abundant everywhere (Balding), Cambridge (Moss), Fulbourne (Raynor), Wicken (Porritt), Boxworth (Thornhill), Ely (Wainwright), Wisbech (Glenny). CARMARTHEN: Llanstephan (Bingham-Newland), Langharne, common (Kaye), Llantrissant (John). CHESHIRE: Bowdon (Thorpe), Chester (Dobie), ? Upton (Arkle). CORNWALL: Truro, common (Stainton), East Looe, Liskeard (Horton), Newlyn, Penzance (Burrows). CUMBERLAND: Carlisle district, singly (Armstrong) [Hodgkinson says this is an error, see *Ent. Wk. Int.*, vol. vii., pp. 102, 159], Keswick, rare (Beadle), Penrith (Hope). DERBY: not uncommon in the southwest of county, Burton district, not infrequent (Payne), Findern (Smallwood), Stapenhill (Thornewill), Derby, rare (Pullen). DEVON: Dawlish (Turner), Newton Abbot (Holdaway), Stoke (Harvie), Chagford, Oxton, near Exeter (Studd), Braunton (Bartlett), Honiton (Riding), Sidmouth (Majendie), Starcross (Hewett), Torquay (Prout), Dartmoor (Gummer), Barnstaple (Cotton), Lynmouth (T. H. Briggs), Tavistock (Phillips), Ilfracombe

(Gardner), Tiverton, Horrabridge (Still), Plymouth very common, Teignmouth (Stainton), Devonport (Dell), Fursdon, near Egg Buckland (Briggs). DONEGAL: Ballyshannon (Bland). DORSET: Blandford, common, Dorchester, very common (Stainton), Chickerell (Payue), Weymouth (Peachell), Portland, one larva (Partridge), Swanage (Hall). DURHAM: Hartlepool, one (Gardner). ESSEX: Epping, very common, Mucking, Southeud, Brentwood, Rainham, Wanstead (Burrows), Chelmsford (Miller), Woodham Mortimer, Great Baddow, Hazeleigh, Danbury (Raynor), Sudbury dist.—Henny (Ransom), Leigh district (Vaughan), East Mersea (Cole), Chingford (McIntyre), Colchester (Harwood), Woodford (Oldham), Southend (Whittle), Hadleigh (Bacot), Goldhanger (Fitch), Rayleigh (Mathew). FERMANAGH: Enuiskillen (Brown). FLINT: Rhyl (Perkins). GLAMORGAN: Swansea district, scarce (Robertson). GLOUCESTER: Bristol district, common, Stapleton (Griffiths), near Stroud (Redmayne), Painswick (Watkins), Cheltenham (Comyn), Northleach (Todd). Lower Guiting (Stainton), Tewkesbury district (Fox). HANTS: Isle of Wight—Sandowu (Sich), Freshwater (Sheldon). Shanklin (Trimen), near Winchester (Broome). New Forest (Capper), Romsey (Buckell), Ringwood (Fowler), Southborne, Wishanger (Bingham-Newland), Hartley Row, Odiham (Holland), Bournemouth (Miller), Horndean (Hawker), Ringwood (Fowler), Fleet (Russell), Winchester, Lyndhurst (Hewett), Basingstoke (Holdaway), Boscombe (Robertson). Southampton (Moberly), Hayling Island (May), Emsworth (Christy), Woolmer Forest (McLachlan), Gosport dist. common throughout—Cosham, etc. (Pearce), Hartley Wintney, plentiful (Claxton). HEREFORD: Leominster (Hutchinson), Tarrington (Wood). HERTS: Waltham Cross (Bowles), Bushey Heath, Hitchin (Barraud), Stanstead Abbot (Image), Hertford (Stephens). HUNTS: St. Ives (Norris). ISLE OF MAN: local and rare—Orrysdale (Crellin), Kirk Michael, Marathon, Douglas (Clarke). KENT: generally distributed (Tutt), Eltham (Jones), Kingsdown (Sheldon), Folkestone (T. H. Briggs), Deal, Dover (Harding), Lee. Mottingham (Bower), Hythe (Heitland), Sidcup (J. A. Clark), Chatham (Tyrer), Ramsgate (Willson), Farningham, Darenth (Barraud), Darenth dist., Greenhithe, Dartford (James), Tunbridge Wells (Dallas-Beeching), Gravesend (Huggins), Shorncliffe (Brown). Wye (Theobald), Rotherhithe (Moore), Brockley (Manger), Lewisham (Fenn). Rochester and Chatham districts, common (Chaney), Rosherville (Andrews), Otford, Southend near Catford (Russell), Strood (Latchmore), Herne Bay (Peachell), Dulwich dist. (Helps), Cheritou (Hill), West Wickham (Barrett), Sydenham (Swain), Teuterden (Stainton), Faversham (Skelton). LANARK: Banks of Kelvin (Brand), near Glasgow (Gray), Possil Marsh (Cross), Glasgow formerly (Stainton). LANCASHIRE: Grange (Murray), Whittle, near Chorley, one example only (Hodgkinson). LEICESTER: Earl Shilton, Fosse Road (Storer), Loughborough (Rowley), Gumley (Matthews), Kibworth (Macaulay), Leicester (Dixon). LIMERICK: Limerick (*teste* Bristow). LINCOLN: Lincoln dist., rare (Carr), Lincoln (Musham), Brant Broughton (Stowe), Grantham (Walpole), Wyberton (Lane-Claypon). MIDDLESEX: generally commou (Godwin), Harrow dist.—Mount Park (Rhoades-Smith), Piuner Drive (Melvill), Kingsbury (Bond), Hackney (J. A. Clark), Enfield (Bowles), Holloway (Jaunes), Stoke Newington (Henderson), Chiswick (Mitchell), Bedford Park (Fenn), Chelsea (A. H. Clarke), Tottenham (Cooper), Teddington (T. H. Briggs). Mill Hill, Ealing (South), Isleworth (Meyers), Shepherd's Bush (Mitchell), Enfield (Edelsten), Kingston (Gower), Kilburn. St. John's Wood (Wormald), Hammersmith and Fulham, formerly, Marble Arch (Mera), Bethnal Green (Milton), Twickenham (Boscher). NORFOLK: Norwich (Moss), Yarmouth (J. A. Clark), Aylsham, Whitwell (Freeman), near Cromer (Cordeaux), Stalham (Edelsten). NORTHAMPTON: Northampton (Hensmau). Kettering (Sturgess), Daventry (Green), Peterborough (Morley), Thurning (T. H. Briggs), Ashton Wold (Prout). NOTTINGHAM: not common—Mansfield, &c. (Daws), Newark (Gascoyne), Sherwood Forest (Talbot), near Nottiugham, abundant (Smith). OXFORD: Caversham (Hendersou), Watlington (Lucas), Hardwick, Henley (Holland), Chinnor (Spiller), Oxford (Poulton). PAISLEY: very rare (*teste* Dalglish). PEMBROKE: Castlemartin, common (Hodge), Pembroke (Barrett), Tenby, abundant (Reynell), Talgarth (Vaughau). RENFREW: very rare (Dalglish). ROXBURGH: Hawick dist., Howgate, one (Guthrie). RUTLAND: Uppiugham (Bell). SHROPSHIRE: Wyre Forest (Rea). SOMERSET: Bristol coalfield dist., common throughout (Hudd), Weston-super-Mare (Head). Tauuton (Tetley), Bath (Greer), Wotton-under-Edge (Perkins), Clevedon (Jefferys), Castle Cary, coumon (Macmillan), Wells (Livett). STAFFS: Stoke (Jahn). SUFFOLK: common (Bloomfield), Brantham (Buckell), Ipswich (Mera), Lowestoft (Moutgomery). Waldringfield (James), Sudbury, common (Ransom), Brandon (Raynor), Stowmarket, common (Stainton), Bentley (Harwood). SURREY: Wands-

worth (Blackmore), Esher (Fleet), Kingston-on-Thames (Cooper), Guildford (Griffiths), Merstham (James), Croydon (Prout), Dorking (Oldaker), Worcester Park (Kaye), Streatham (Henderson), Leatherhead (T. H. Briggs), Box Hill (Trimen). SUSSEX: common (Jenner), Groombridge (Blaber), Worthing, common, Brighton, very common, Lewes (Stainton), Eastbourne (Sich), Tilgate Forest (T. H. Briggs), Bognor, common (Lloyd), St. Leonards (Barraud), Rye (Henderson), Wannock (Pearson), Chichester (Anderson), Hurst Green (Eddrup), Arundel, Bersted (Fletcher), Hastings dist. (Bloomfield), Burgess Hill (Dollman), Cuckfield, Ovingdean (Merrifield), Firle (Edgell). WARWICK: Rugby (Wilson), Birmingham (Imms), Salford Priors (Fountain), Solihull (Martineau), Brandon Wood (Peachell). WILTS: Bremhill, Calne (Eddrup), Devizes (Sladen). WORCESTER: Great Malvern (Mitchell), Malvern Wells (Sich), Worcester, common, Bransford (Rea), Trench Woods (Harrison). YORKS: rare in Yorkshire (Porritt), Doncaster, Scarborough (Stainton), York dist. (Anderson), Hull (Young), Ingleby Greenhow, Northallertou (Elgee), Harrogate (A. H. Clarke), Hutton Gate, Cleveland (Lofthouse), Barnsley, rare (Brady), Southcoats Lane in 1884 (Russell), Bridlington (Lawson), near Castleford (Smethurst), Selby (Hebson), Sheffield (Doncaster), Wakefield (Talbot), York (Ripley).

DISTRIBUTION.—Throughout the Palæarctic area, excluding the Polar regions. AFRICA: northwest Africa (*teste* Bartel), Canary Islands (Speyer), Azores (Goodman). ASIA: Asia Minor—Brussa, Bithynia, Armenia (Staudinger), Altai (Pallas), southwest Siberia—between Ust-Kamenogorsk and Ust-Buchtarminskaja (*teste* Bartel), northern Amurland (Staudinger as var. *amurensis*), North China, Japan (Leech as var. *constricta*), Isle of Askold (Oberthür). AUSTRO-HUNGARY: Tyrol (Hinterwaldner)—Trient, Bozen (*teste* Bartel), Innsbruck, Taufers valley (Weiler), Fiume* (Mann), Lavantthal (Höfner), Bucovina, common in valleys, singly in mountain districts—Czernowitz, &c. (Hormuzaki), Pressburg (Rozsay), Bohemia—Carlsbad (Nickerl), Buda, common (Speyer), Galicia—Lemberg, Sambor (Nowicki), Brünn (Schneider), Agram, Friestadt, Kaschau, Kremsier, Neusohl, Neutitschein (Fritsch), Salzburg (Nickerl), Hermannstadt (Czekelius), Eperies, not rare (Husz), Hungary—Kocsocz (Vángel), Gölnitz (Hudák), Upper Styria—St. Lambrecht (Kodermann), Admont (Kiefer), Carinthia—Pörtschach (Wagner), Upper Austria—Linz district, nowhere rare (Himsl), Vienna, Moravia—Brünn, Ungarisch-Brod, Hungary, common—Neusohl, Raab, Heveser district, Fünfkirchen, Transsylvania, Josefsthal, Croatia (*teste* Bartel). BELGIUM: common throughout (Lambillion), Bomel, Namur, common (Derenne). BULGARIA: near Varna (*teste* Bartel). CHANNEL ISLES: not common, Guernsey, Sark (Luff). DENMARK: generally distributed (Bang-Haas), Jutland, Zealand (*teste* Bartel). FRANCE: pretty common (Berce), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir, always singly (Guenée), Haute-Garonne, quite rare—Toulouse, St. Béat (Caradja), Puy-de-Dôme—Claremont, rare (Guillemot), Maas, Moselle, Meurthe districts (Speyer), Var (Cantener), Marseille (Siepi), Nice (Casey), Hyères (Powell), Morbihan—Vannes, &c. (Griffith), Gironde (Trimoulet), Doubs—Belfort, La Chapelle, Rougemont (Bruand), Aude, common (Mabille), Loire-Inférieure (Bonjour), Saoue-et-Loire (Constant), Seine-Inférieure (Viret), St. Quentin (Dubus), Deux-Sèvres (Maillard), Paris district—Parc Maison Lafitte, Port Marly (Walker), Aix-les-Bains (Agassiz), dept. Sarthe, Brittany, common, Rennes, Cancale (Oberthür), Châteaudun (Guenée), Château-du-Loir (de Graslin), Evreux (Bellier-de-la-Chavignerie), throughout the French Pyrenees (Oberthür), FINLAND: Abo, Nyland (Lampa). GERMANY: everywhere (Heinemanu), northwest Germany, almost everywhere (Jordan), southwestern Germany—Frankfort, Darmstadt, Mayence, Hanau, &c., absent from beyond Ober-Hessen (Koch), Lübeck (Paul), Rhiue Palatinate, very common (Bertram), Würtemberg (Seyffler), Giessen, rare (Dickoré), Lower Elbe district (Zimmermann), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich, very common (Kranz), Rudolstadt, not rare (Meurer), Mecklenburg, very distributed and common (Schmidt), Bremen (Rehberg), Saxon Upper Lusatia, not rare (Schütze), Dresden (Steinert), Thuringia, only in lowlands, distributed and not rare (Krieghoff)—Gotha, Erfurt, Arnstadt, &c. (Knapp), Prussia, everywhere common (Grentzenberg), Silesia, many places, nowhere common (Assmann), Sprottau (Pfützner), Upper Lusatia, common (Moeschler), Nassau (Rössler), Ratisbon (Schmid), Waldeck, Oberharz (Speyer), Dessau (Richter), Wernigerode, common (Fischer), Pomerania, not rare—

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* Mann makes the remarkable statement that a hybernated example was found in a cleft in a rock at Fiume at the end of April.

Dramburg, Stettin (Hering), Grimmer district, Anclam, Stralsund, Wiesbaden (Homeyer), Bruuswick, uot rare (Heinemann), Hanover, often common (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Braunfels (Sich), Chemnitz (Pabst), Elberfeld (Weymer), Hildesheim (Grote), Heligoland (Gätke), Berlin district, common (Pfützuer), Potsdam, Magdeburg, Schwerin, Holstein, Isle Sylt, Crefeld, Barmen, Cassel, Leipzig, Geva, Kempten, Frankfort-on-Main, Rüdesheim, Wetterau, Bad Neuheim, Trier, Bavarian Palatiuate (*teste* Bartel), Alsace—Colmar, Mülhausen (Peyerimhoff), Baden — Constance, Ueberlingen, Carlsruhe, Mannheim, Mayence (Reutti). ITALY: pretty frequent throughout (Curò), Modena — Fiumalbo (Fiori), Roman Campagna (Calberla), Sicily—Monreale, Palermo (Maun), Lombardy, Piedmont, Liguria, Sardinia, Tuscany—Lucca, Pisa, Florence (Mann *teste* Bartel). NETHERLANDS: pretty commou throughout (Snellen), Zevenhuizen (Lechner), Breda (Heylaerts). PORTUGAL (*teste* Bartel). ROUMANIA: very rare—Costischa, Comanesti, Jasi, Tulcea-in-Dobrudscha (Caradja). RUSSIA: Baltic provinces, throughout (Nolcken), Livonia—Dorpat (*teste* Bartel), Moscow govt. (Albrecht), Transcaucasia, rather rare—Borjom, Tiflis, Derbendt (Romanoff), Crimea (Melioransky), Volga district (Eversmann), St. Petersburg (Erschoff), Gorki, Poltawa district—Lubny, Aluschta (*teste* Bartel), Kasan district, Saratov, Ural district, Orenburg district, Sarepta (Eversmann). SCANDINAVIA: commou up to 60° N. lat., found as far north as Helsinglaud, where it is very rare (Aurivillius), Uplaud, west coast at least as far as Götheberg, &c. (Wallengren), Norway—frequent, Christiania, Drommen, Skien, &c. (Siebke), Swedeu—Scania, Norway—southern parts (Lampa), Lyngör (Strand). SPAIN: central Spaiu (Staudinger). SWITZERLAND: only iu the valleys—St. Galleu, very commou (Täschler), Berne, not rare (Meisner), near Bremgarten (Boll), Wiggerthal, the Eugelberg in Jura, in the Aarthal from Morgenthal to Coblenz, Lenzburg, Born, the upper Hauenstein, Vevey (Wullschlegel), the Valais (Riggenbach), Neuenstadt, not common (Couleru), near Schüpfen, rare (Rothenbach), near Zürich (Frey), Winterthur (Biedermann), Schaffhausen (Trapp), Weissenburg (Huguenin), Grisons (Killias), Basle, Bechburg—near Oensingen (Riggenbach-Stehlin), Berue (Hiltbold), Thun (Jordan), Zürich (Nägeli), Glarus (Speyer). TURKEY: Eastern Roumelia—near Slivna (*teste* Bartel).

Tribe: AGRIIDI.

Genus: AGRIUS, Hübner.

SYNONYMY.—Genus: *Agrius*, Hb., "Verz.," p. 140 (*circ.* 1822); Stephs., "Illus. Haust.," iv., app. p. 5 (1835); "List Br. An. Brit. Mus.," v., p. 27 (1850); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, Linn., "Sys. Nat.," xth ed., p. 490 (1758); xiith ed., p. 798 (1767); "Mus. Ludov. Ulric.," p. 345 (1764); Poda, "Ins. Mus. Graec.," p. 80 (1761); Scop., "Ent. Carn.," p. 184 (1763); Hufn., "Berl. Mag.," ii., p. 176 (1766); Fab., "Sys. Ent.," p. 544 (1775), "Spec. Ins.," ii., p. 150 (1781); "Mant. Ins.," ii., p. 97 (1787); "Ent. Sys.," iii., pt. 1, p. 374 (1793); [Schiff.,] "Schmett. Wien.," ed. 1, p. 41 (1775); ed. 2, p. 9 (1801); Esp., "Schmett. Eur.," ii., p. 52, pl. v., figs. 1—3 (1779); Bergstr., "Sphing. Eur. Larv.," p. 5 (1782); Bkh., "Sys. Besch.," ii., p. 97 (1789); Brahm, "Insectenkal.," ii., pt. 1, p. 522 (1791); F. J. A. D. "Rhein. Mag.," p. 318 (1793); Hb., "Eur. Schmett.," fig. 70 (*circ.* 1800); text p. 98 (1805); "Larvæ Lep.," ii., Legit. C. b. fig. 1*a-b*, and C. c. fig. 1*a*. (*circ.* 1800); Lam., "Syst. An. sans Vert.," pp. 281, 282 (1801); Schrk., "Faun. Boica," ii., pt. 1, p. 223 (1801); Latr., "Hist Nat.," iii., p. 401 (1802); xiv., p. 130 (1805); "Gen. Crust.," iv., p. 210 (1809); Haw., "Lep. Brit.," i., p. 58 (1803); Ochs., "Die Schmett.," ii., p. 236 (1808); iv., p. 44 (1816); Leach, "Ency. Edinb.," ix., p. 131 (1815); Dalm., "K. Vet. Ac. Handl.," p. 213 (1816); Sam., "Ent. Comp.," p. 244 (1819); Godt., "Hist. Nat.," iii., p. 26, pl. xvi (1820-1); Stphs., "Illus.," i., p. 119 (1828); "Cat. Br. Ins.," pt. 2, p. 31 (1829); Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); "Gen. et Ind. Meth.," p. 48 (1840); "Sp. Gén. Lép. Hét.," i., p. 94 (1875); Meig., "Eur. Schmett.," ii., p. 144 (1830); Wood, "Ind. Ent.," p. 12, fig. 11 (1839); Dup., "Hist. Nat.," supp. ii., p. 157 (1835); "Icon. Chen.," pl. i., fig. 2 (*circ.* 1840): "Cat. Méth.," p. 41 (1844); Westd. & Humph., "Brit. Moths," p. 12 (1842); Evers., "Faun. Volg.-Ural.," pp. 108—112 (1844); Assm., "Schmett. Schles.," ii., p. 37, pl. xiv., fig. 39*a*—*e* (1845); H.-Sch., "Sys. Bearb.," ii., p. 90 (1846); Heydenr., "Cat.," p. 18 (1851); Brem. & Grey, "Schmett.-Faun. des Nörd. Chin.," p. 11 (1853); Walk., "List Lep. Ins. Brit. Mus.," viii., p. 212 (1856); Sta., "Man.," i., p. 89 (1857); Speyer, "Geog. Verb.," i., p 322 (1858); ii., p. 280 (1862); Hein., "Schmett. Deutsch.,"

p. 148 (1859); Humph., "Gen. Brit. Moths," p. 9 (1860); Staud., "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 36 (1871); Wallgrn., "Skand. Het.," ii., p. 29 (1863); Rbr., "Cat. Lép. And.," p. 135 (1866): Snell., "De Vlind.," pp. 97—98 (1867); Berce, "Faun. Franç.," ii., p. 14 (1868); Nolck., "Lep. Fn. Estl.," i., p. 87 (1868); Newm., "Brit. Moths," p. 6 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 402 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 38 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 117 (1875); Curò, "Bull. Soc. Ent. Ital.," vii., p. 109 (1875); Kirby, "Eur. Butts. and Moths," p. 68 (1879); Frey, "Lep. Schweiz," p. 56 (1880); Buckl., "Larv.," ii., pp. 22, 108, pl. xxi., fig. 2, pl. xxii., fig. 1 (1887); Leech, "Proc. Zool. Soc. Lond.," p. 588 (1888); Poulton, "Trans. Ent. Soc. Lond.," pp. 515-606 (1888); Auriv., "Nord. Fjär.," p. 44 (1889); Meyr., "Handbook," &c., p. 298 (1895); Barr., "Lep. Brit.," ii., p. 22, pl. xlv (1895); Tutt, "Brit. Moths," p. 26 (1896); Sturt. "Ent. Rec.," vii., p. 226 (1896); Bartel, "Pal. Gross-Schmett.," ii., p. 38 (1899). *Herse*, Oken, "Lehrb. Zool.," i., p. 762 (1815); Distant, "Insecta Transv.," p. 73 (1903); Roths. & Jord., "Rev. Sphing.," p. 11 (1903). *Protoparce*, Butl., "Trans. Zool. Soc. Lond.," ix., p. 609, pl. xci., figs. 16-17 (1877); Moore, "Lep. Cey.," ii., p. 5 (1882); Hmpsn., "Ind. Moths," i., p. 103, fig. 60 (1892); Leech, "Trans. Zool. Soc. Lond.," p. 286 (1898); Staud., "Cat.," ed. 3, p. 101 (1901). *Macrosila*, Butl., "Papilio," ii., p. 7 (1882). *Phlegethontius*, Kirby, "Cat.," p. 687 (1892); "Handbook," &c., iv., p. 45 (1897).

The genus *Agrius* was founded (*Verz.*, p. 140) about 1822, by Hübner, who diagnosed it as follows:

The hindwings and the abdomen red- and black-banded—*Agrius anchemolus*, Cram., *A. convolvuli*, Linn., *A. cingulatus*, Hb. (*cingulata*, Fab.=*convolvuli*, Cram.).

Stephens, in 1835, cited *convolvuli* as the British exponent of Hübner's genus, and maintained the name in his *List* in 1850. Kirby in his *Catalog*, p. 687, sinks the genus as being identical with *Phlegethontius*, a view with which we are entirely unable to agree (see *anteà*, p. 273). Kirby's genus *Phlegethontius*, indeed, includes the whole of the Phlegethontiids and Agriids. As compared with the *Sphingidi*, the *Agriidi* have a much smaller egg, the adult larva is not so markedly specialised by the swollen thoracic segments which characterise the larva of *Sphinx ligustri*; the pupa has a very large tongue-horn, agreeing with the much more highly developed maxillæ of the imago. The tribe *Sphingidi*, too, comprises what we may term sedentary species of comparatively limited distribution—*ligustri* being the most widely distributed, whilst the *Agriidi* are species of wide distribution—one of the two typical species of *Agrius*, *cingulata*, being, however, confined to America, the Galapagos and Sandwich Islands, the other, *convolvuli*, ranging over almost the whole of the world, except America. Kaye gives us (*in litt.*) the following diagnosis of the genus:

Head large, tongue very long. Forelegs strong, the tibia with a few very stout spines and a number of weak ones; middle and hindlegs long, the tibia and tarsus together, in the latter, fully half as long again as in the forelegs. The tibia of hindleg with two pairs of stout spurs, each pair consisting of a long and a short spur, the long one being fully twice the length of the short one. Antennæ in the ♂ heavily bipectinated, in the ♀ the shaft smooth and very considerably thickened towards apex; the hook small and terminated by a single bristle. Forewings long and narrow; the costa quite straight in both sexes to immediately above origin of nervure 7, thence evenly curved to costa, apex rather acute in ♂ less so in ♀; outer margin evenly curved to tornus, inner margin well excised to well beyond middle. Abdomen stout, greatly tapered, the thorax very broad - *Agrius* (type *convolvuli*).

AGRIUS CONVOLVULI, Linné.

SYNONYMY.—Species: *Convolvuli*, Linn., "Sys. Nat.," ed. x., p. 490 (1758), ed. xii., p. 798 (1767), &c. [NOTE.—This species has never been known by any other specific name from the time of Linné, although some varieties of it have been described as distinct species. All the references made under the generic synonymy of *Agrius*, Hb., *anteà*, p. 329, are referable here.]

ORIGINAL DESCRIPTION.—*Sphinx conuoluuli*, alis integris : posticis albo fasciatis margine postico albo punctatis, abdomine rubro cingulis atris. Merian, *Ins.*, 39, t. 75, f. 2, t. 25. Goed., *Ins.*, 3, t. 5. Roes., *Ins.*, i., phal. 1., t. 7. Wilk., *Pap.*, 10, t. 1, B. 2. Habitat in Convolvulo. Thorax antice arcubus 2 nigris. Alæ posticæ cinereæ fasciis 3 fuscis (Linné, *Sys. Nat.*, xth ed., p. 490). [In the xiith ed., p. 798, "posticis albo fasciatis" becomes "posticis nigri fasciatis."]

IMAGO.—63mm.—125mm. Head and thorax same colour as forewings. Abdomen with broad median grey longitudinal band, enclosing a slender black mediodorsal line; the sides pink- and black-banded, the black edged with white posteriorly. Anterior wings grey; a double black curved wavy transverse line cutting off the basal third of the wing which is usually somewhat paler than the median area; beyond the middle is another fine pale sharply-zigzag transverse line edged on either side with black, and sloping very obliquely towards base in its lower half; the median area between these transverse lines darker, especially the upper half; the darker area including two conspicuous longitudinal linear black streaks which are surrounded by a median fuscous shade directly beneath the paler discoidal spot; the outer marginal area marbled with whiter grey; a marginal row of interneural arcuate markings pointing outwards, from the middle of which two dark shades run to the fuscous median area; a conspicuous black apical mark running obliquely to outer transverse line; fringes latticed with grey, white and black. Posterior wings grey, with basal, double median, and outer, transverse black bands; the areas between the basal and median and the median and outer bands whitish-grey; the outer margin slightly slaty-grey; fringes latticed with dark grey and white. [The frenulum is figured by Van der Hoeven, *Bijd. Nat. Wet.*, ii., pl. iii., fig. 1.]

SEXUAL DIMORPHISM.—The ♀ seems to be rather larger than the ♂, my largest specimen being a ♀ 117mm. in expanse, the largest ♂ being 111mm., whilst the smallest is a ♂, 76mm., the smallest ♀ being 78mm., the general impression being that there is some such difference of a few millimètres in favour of the ♀. Individual, and still more geographical, variation obscures any difference of form, colour, markings, &c., but the impression is that there are no such differences. The abdomen of the ♂ tapers more regularly, that of the ♀ maintains its dimensions for 4 or 5 segments before tapering. The antennæ differ markedly between the sexes, whilst the actual dimensions differ nearly as much as the specimens in size. A large ♂ has antennæ 20mm. in length, and one with exceptionally long antennæ has them 22mm., but, in a good-sized ♂, they are usually about 18mm. to 19mm., a very small ♂ has them 15mm. The ♀ antennæ are much shorter, the average is, perhaps, about 13mm., though a good many reach 14mm., one specimen only just passing 15mm., a very short antenna in small specimens is about 12mm., and one exceptional one 11·5mm. The ♂ antenna is also much more robust, tapering basally for 6 or 7 visible joints and from 8 or 10 distally before the recurved tip, the rest of the antenna (about two-thirds of it) being of uniform thickness; the ♀ antenna varies in robustness, but is much more slender than that of the ♂, is very slender basally, and thickens gradually but very slightly

for half its length, then more rapidly, reaching its greatest thickness 2mm. from the extremity, terminating very abruptly just before the recurved tip, and so is very clubbed. The thickness of the ♀ antenna is about 0·4mm. near the base, 0·7mm. at the club, that of the ♂ is about 0·9mm. throughout. There are just over 60 joints in the shaft, and about 12 in the curved tip, this seems to be substantially the same in both sexes. The scaling differs in the two sexes, in the ♀ it preserves, almost typically, the ordinary Sphingid scaling of three rows of scales of which one is very narrow; the broadest or terminal row on each joint is usually white and all may be, the others are, however, usually of dark, pale and white scales irregularly mixed. The ♂ antenna has the terminal row of long scales paler than the others and sometimes white, but the general rule is for the ♂ to have in this row and the others a larger proportion of dark scales. The other rows of scales on the ♂ antennæ are very much mixed up on the nearer part of the shaft, so that definite rows hardly exist, but appear to result from three or even more rows becoming irregular; beyond the middle, however, they are arranged in three quite definite if not very smoothly arranged rows. There is thus one extra row of scales on the ♂ antenna, with a tendency for them to lose their definite arrangement. The first tibiæ and their spurs appear to be almost exactly alike in the two sexes, a very slight advantage in size and development of the ♂ may exist, but the evidence of it is not greater than the frequent variation in size of the insects themselves might account for. The wisp of hairs forming the scent fan of the ♂ arises from the margin of the ventral plate just below the 2nd spiracle. The hairs are about 5mm. long but the fan is not copious. The area of origin is about 1mm. long by ·3mm. wide (Chapman). Bartel notes (*Pal. Gross-Schmett.*, ii., p. 40): "The ♀ is distinguished from the ♂ by the forewings being of a lighter colour and with weaker markings; the whitish spot at the end of the discoidal cell is also much duller, smaller, scarcely surrounded with black, so that it fades off into the ground colour."

GYNANDROMORPHISM.—The following are the described gynandromorphs of this species that we have so far met with:

α. Right side ♂, left side ♀. Antenna and wings on the right side ♂ on the left side ♀. The right eye larger. The body on the right side visibly shrunken (Ernst, *Pap. d'Europe*, iii., p. 123, pl. cxxii., fig. 114 *l*).

β. Right side ♂, left side ♀. Perfectly halved as to antennæ, thorax, wings and abdomen. Captured near Münster (Altum, *Stett. Ent. Zeitg.*, 1860, p. 91).

γ. Left side ♂, right ♀. Right antenna ♀, left ♂. Right eye smaller. The grey median stripe of the abdomen bends out in a curve on the right and curtails the rose-coloured transverse stripes, one of which on the right side is absent; abdomen somewhat crooked. As to the rest the ♂ sex is predominant. The ♀ wings are somewhat smaller, the costa of the forewing more arched, their colour somewhat darker than usual, approaching that of the ♂. Thorax of ♂ coloration, the right patagia shorter, though similarly coloured. Captured near Münster (Altum, *Stett. Ent. Zeitg.*, 1860, p. 91).

δ. Right side ♂, left ♀. Wings and antenna on the right side ♂, on the left ♀ (Pierret, *Bull. Soc. Ent. France*, 1842, p. liv).

ε. Left side ♂, right side ♀. Halved gynandromorph. Abdomen asymmetrical. In coll. Forstakademie, at Eberswald. [Perhaps the same as γ.] (Eckstein, *Ber. d. Oberhess. Ges. f. Natur- und Heilkunde*, xxvi., p. 3, pl. ii., fig. 3).

ζ. Left side ♂, right side ♀*. Perfect gynandromorph. Left ♂ forewing shorter than the right ♀ wing. Left ♂ antenna strongly ciliated, larger than the

right ♀ antenna. Left eye apparently larger. Thorax unequally coloured, left side more sharply and brightly than the right. Right forewing more purely grey than the left. The black wavy bands on the left hindwing much more strongly expressed. Abdomen sharply divided in the centre, somewhat curved, shrunken on the right side at the anal point; six abdominal segments clearly shown on both sides, on the left side a 7th also indicated. In coll. Naturh. Museum at Wiesbaden (Pagenstecher, *Jahrb. des Nass. Ver. f. Naturk.*, xxxv., p. 88).

VARIATION.—The species is exceedingly variable in tint, size, and brightness of the markings, but for its great range of distribution may be said to be little subject to marked variation, this fact being due possibly to its migrating habits and the consequent tendency to interbreeding over very wide areas, and the natural absence of segregation. In our opinion the small, dark, Australian and New Zealand form, *roseafasciata*, Koch, is the most marked, and most worthy of being considered a distinct race. The Javanese examples, placed in the series of var. *orientalis*, in the B.M. coll., also appear to be a dark and very specialised race, approaching closely to var. *roseafasciata*, the ♂s brightly and strongly marked, the ground colour suffused with brownish; the red of the abdomen, of a distinctly dull hue=var. *javanensis*, n. var. The form in which the red bands of the abdomen are obsolete may apparently be referred to ab. *abadonna*,† Fab. In the *pot pourri*, collected together from all parts of Asia, in the British Museum coll., under the name of var. *orientalis*, is an exceedingly fine local race from Ichang, the ♂s of a stone-grey ground colour, prettily marbled with darker, the transverse lines distinct, and with a very marked rosy flush over the disc of the wings; the ♀ unicolorous stone-grey=var. *ichangensis*, n. var. The Tahitian race, too, is distinctly specialised; it is small in size, the forewings of a very uniform brown-grey tint, with moderately sharp black and white transverse lines; the hindwings somewhat suffused; the abdomen with very faint pink bands=var. *tahitiensis*, n. var. *(distans*, Druce, *pro parte)*. The Eimeo examples are of the same form, but are sometimes strongly variegated, whilst the Pitcairn Island specimen in the

* This is the same as *a*, unless some mysterious metamorphosis has taken place, at any rate, both are the example from the "Gerning coll.," which Borkhausen notes (*Rhein. Mag.*, i., p. 318). The description given (*suprà* p. 332) of Ernst's fig. 114 *l* is quite accurate so far as the evidence of the figure goes, but the text only says that one side is ♂ and the other ♀, and I can only suppose that the artist has used some method of transference which has resulted in the right side being depicted left and *vice versa*. All that Pagenstecher says of the specimen tallies with Ernst's fig., *mutandis mutatis* (Prout).

† One suspects that the Fabrician *abadonna* may be a specimen of the East Indian form in which the usual pink abdominal bands have failed. The original description reads as follows: "*Sphinx abadonna*, Fab., "Ent. Syst.," suppl. p. 435 (1798).—*Sphinx* alis integris cinereis anticis nigro striatis, posticis fasciatis, abdomine maculis lateralibus atris. Habitat in India orientali. Dom. Doldorff. Statura omnino *S. convolvuli* at duplo minor. Antennæ albæ squamis fuscis. Caput album. Thorax albo nigroque variis. Abdomen cinereum maculis lateralibus atris. Alæ cinereæ maculis striisque variis fuscis. Posticæ cinereæ fasciis nigris. Subtus anticæ obscuræ, posticæ cinereæ strigis undatis, fuscis." If the determination of Aurivillius (*Ent. Tids.*, xviii., p. 153), *viz.*, that "*Sphinx abadonna*, Fab.=*Protoparce convolvuli*, L. var. *orientalis*, Butl.," be correct, and the opinion formed has been based on the examination of the actual type in the Danish Museum, then the description can scarcely agree with the moth, unless the latter be an aberration in which the coloured abdominal bands are more or less obsolete. On the other hand, Kirby considers (*Trans. Ent. Soc. Lond.*, 1877, p. 238) that "*abadonna*, Fab. =*godarti*, MacLeay," a well-known species, described, under the latter name, in King's *Survey of the coasts of Australia*, ii., p. 464, and is still of the opinion (*in litt.*) that the Fabrician description fits this insect, whilst it certainly does not fit normal *convolvuli* var. *orientalis*.

B. M. coll. is an even more markedly dark variegated individual. Bartel notes (*Pal. Gross-Schmett.*, ii., p. 40) that, "according to Alphéraky, the ♀s of this species reach, in southern Russia, a wing-expanse of 115mm.-116mm., which are, however, surpassed by Austrian and Hungarian examples, some from Vienna measuring 122mm.; on the other hand, Treitschke records (*Die Schmett.*, x., pt. 1, p. 139) that he bred one in autumn from a backward larva, which was not larger than *Hyles euphorbiae*, and was, moreover, whitish-grey in colour—Bartel also adds that a ♀, not larger than a medium-sized specimen of *Hyloicus pinastri*, was bred from a larva found on *Zygophyllum fabago* in the Mugan-Steppe (west of the Caspian Sea), and which was similar in appearance to a larva of *Deilephila zygophylli*, otherwise the specimen was quite typical. Steinert mentions (*Iris*, v., p. 396) an aberration, in which, on the upper side of the thorax, there was a large bell-shaped spot. The specimen was captured in the Kötzschenbroda district near Dresden. A light-grey, very sharply marked, form of the species, of only moderate size is reported as occurring at Gravosa (Dalmatia) and in the Riviera (at Nervi). Alphéraky further gives an aberration of the ♂ from the Lob-nor district (Central Asia) which is noteworthy on account of its very pale colour and very weak markings, and also differing especially from all examples from the most varied localities in having a yellowish tinge. A further very interesting aberration is described in detail by Bonjour (*Bull. Soc. Ouest France*, vi., p. 29, 1896). It was caught at Nantes, on August 8th, 1895, and may be regarded as a transition to an albinistic form. The more or less bright red spots on the sides of the abdomen are here pale yellow in colour; the uppermost of them, on the first segment, is dark yellow and very small, the black colour bounding it is, on the other hand, as in the typical form; a yellowish tinge also extends over the middle of the forewings. A ♀ aberration which was in the possession of Ochsenheimer (*Die Schmett.*, iv., p. 182) was tinged with rose-red, instead of white-grey, both on the whole body and also the fore- and hindwings. Caradja, in his Fauna of Roumania, mentions a quite dark example, looking as if sprinkled over with soot, which he caught at Grumazesti. A similar specimen has also been recorded as caught in Berlin. Examples from tropical Asia and Africa are usually smaller and have paler red spots on the sides of the abdomen." Gauckler records (*Illus. Zeits. für Ent.*, iv., p. 74) that, on October 27th, 1898, he reared a specimen with the inner margin of the forewings almost without scales, the red hairs of the abdomen also being absent; examination showed that these scales had fully developed in the ordinary course but had stuck to the inside of the pupa-case, and he thinks that a similar peculiarity may be the explanation of like examples in other species. Distant notes (*Ins. Transv.*, p. 73) that the South African specimens are much smaller than the European, having on an average, only about two-thirds of the wing expanse. As extremes in size we would call those of more than 120mm.=ab. *major*, n. ab., and those less than 75mm.=ab. *minor*, n. ab. Roughly our European, Asiatic and African specimens appear to fall into the following groups:

(1) Forewings uniform ashy-grey with the transverse markings only most faintly indicated; a distinct wavy black apical line; two linear black discal streaks. Hindwings moderately marked, sometimes slightly suffused=ab. *unicolor*, n. ab.

(1a) Forewings uniform suffused dark grey, with scarcely perceptible transverse markings. Hindwings also suffused=ab. *grisea*, n. ab.

(2) As in 1, but with the transverse markings darker, although without any very definite tendency for the median area to be banded=ab. *intermedia*, n. ab.

(3) As in 2, but with marked brown scaling in the median area of forewings=ab. *fuscosignata*, n. ab.

(4) As in 2, but with the median area very much darker than the rest of the forewing. Hindwings usually clearly marked=ab. *virgata*, n. ab.

(5) Forewings with the outer and basal areas with much pale (or whitish) scaling, the dark median and the outer marginal area of wing affording a marked contrast. Hindwings usually clearly marked=ab. *variegata*, n. ab.

(6) The dark tint much extended over the forewings, the pale grey marks restricted to the neighbourhood of the basal and outer wavy lines. Hindwings usually much suffused=ab. *suffusa*, n. ab.

(7) The dark tint covering the whole of the forewings, obscuring the usual markings, and producing a distinct melanochroic result. Hindwings also much suffused=ab. *obscura*, n. ab.

The following are the named forms of this species :

α. ab. *alicea*, Neuburger, "Illus. Zeits. für Ent.," iv., p. 297 (1899).—The markings of the upper surface as in the type, but very dark. Thorax and epaulettes as in very dark specimens of the type, abdomen not grey but golden-brown sprinkled with red-gold scales. The black line which intersects the abdomen is, in consequence of this, almost invisible. On the sides, the ordinarily rose-red spots are red-gold and are not white-margined as in the type. The sides of the abdomen are a mixture of yellow-brown, grey and brown, its underside is brown-grey, on the anus green-grey, the anus is sprinkled with red dots. Breast and legs grey-yellow. The underside of abdomen shows the two black spots of the type, with which the specimen also agrees in the rest of its characters. Size somewhat smaller than the type. Described from a ♂ caught at Fürstenwalde-on-the-Spree, but other similar dark specimens have also been seen (Neuburger).

β. var. *batatae*, Christ, "Mitt. Schwer. Ent. Ges.," vi., p. 346 (1882); Alph., "Rom. Mem.," v., p. 223 (1889); Bartel, "Pal. Gross-Schmett.," ii., p. 43 (1899).—Differs from the type in its smaller size, more slender build, and more unicolorous tint. The markings, especially those on the hindwings, are weaker than in the type. The insect might be, so far as its slender build is concerned, a large *Deilephila*, the wing expanse of the ♀ being 98mm. of the ♂ 93mm., whilst a ♂ *convolvuli* from Lugano measures 115mm. A preserved larva (which I saw in spirits of wine) did not differ from the typical grey form of the larva of *convolvuli*. The larva lives on the cultivated *Convolvulus batatas*. Locality: Teneriffe (Christ).

Alphéraky notes that the specimens from the Canary Isles are smaller, as Christ has observed, but that he could not confirm his view that the forewings of the ♂s are less sharply marked than the ordinary continental examples; he considers that there appears to be more brown colouring on the forewings than in European individuals, but that, on the whole, the Canary form seems hardly to require a special name. [See also Poulton, *Trans. Ent. Soc. Lond.*, 1888, p. 554.]

γ. var. *orientalis*, Butl., "Trans. Zool. Soc. Lond.," ix., p. 609 (1877); Moore, "Lep. Cey.," p. 5, pl. lxxv (1882); Kirby, "Cat.," p. 690 (1892); Bart., "Pal. Gross-Schmett.," ii., p. 43 (1899). *Convolvuli*, Leech, "Trans. Ent. Soc. Lond.," p. 286 (1898).—This species is wonderfully like some African examples of *P. convolvuli*, being altogether paler than the European form, it differs from the African variety in always having the centre of the middle band of secondaries quite pale, and paler rosy bands on the abdomen; the larva differs considerably, being more slenderly formed, and without the double dorsal series of black spots. It feeds on the sweet potato. North India (James Hearsay), Scinde? (Harwick), North Bengal (Saunders), Moulmein (Clerck), Ceylon (Templeton), Hong Kong (Bowring), Java (Horsfield), Hakodate (Whitely), Aden (Yerbury) [Butler].

Butler gave the name *orientalis* to the Asiatic specimens of *convolvuli*, which are often, indeed, not to be distinguished from African or European examples. Moore gives a detailed description of the imago, which he says measures from $3\frac{1}{4}$ins.—$3\frac{3}{4}$ins., also some notes on the larva in its various stages; he gives *Calonyction speciosum*,

Pharbitis nil, *Argyreia cymosa*, *Ipomaea polyanthes*, *Phaseolus*, &c., as foodplants of the larva. Leech unites *orientalis* with *convolvuli* (*Proc. Zool. Soc. London*, p. 588), and remarks: "Having regard to the great variability and extensive geographical range of the species, I am at a loss to understand how anyone can attempt to claim specific rank for representatives of *convolvuli* coming from any part of the Old World." Later, in the *Trans. Ent. Soc. London*, 1898, p. 286, he states that he has specimens from Yokohama, Fushiki and Hakodate in Japan, Chang-Yang and Ichang in Central China and Chung-King in Western China. Fletcher writes (*in litt.*): "I found the pupa during the 1st week of June, 1897, on the sandy beach at Kamakura (near Yokohama) where *Convolvulus* is abundant. My next acquaintance with the insect was on May 13th, 1898, when I found a very worn specimen at rest on a wall at Chifu. In September, 1900, we did a little cruise up the Gulf of Pechili, to Shan-hai-Kwan, *viâ* Chifu, &c., and the insect was everywhere common, and came to light almost every night." Oberthür notes (*Etudes*, v., p. 28) a ♀ of large size, taken on September 20th, 1877, in the Isle of Askold.

δ. var. *roseafasciata*, Koch, "Indo-Aust. Lep. Fauna," p. 54 (1865). *Distans*, Butl., "Cat. Lep. N. Zeal.," p. 30, pl. ix., fig. 11 (1874); Druce, "Proc. Zool. Soc. Lond.," p. 220 (1888). *Convolvuli*, Meyr., "Trans. N. Zeal. Inst.," xxii., p. 213 (1890); Hudson, "New Zealand Moths and Butts.," p. 99 (1898). *Roseofasciata*, Kirby, "Cat.," p. 690 (1892).—Besides Europe, *convolvuli* flies on the north and west coasts of Africa, northern Bengal, all India, China, Ceylon, Java, and other places, and I have received it in abundance from New South Wales and Queensland. Mr. Scott considers this unimportant Australian variety to be a good species, and has called it *roseafasciata*, but the Australian insect is nothing more than a dwarf form of *convolvuli*, and there are some ♀s nearly as large as European ♂s. MacLeay shares my view. Considering the small number of Australian Sphingids, it is remarkable that so many of them are to be found in the East Indies and the Sunda Isles (Koch).

This is the most marked race of the species, although the specimens vary much *inter se*; it is of rather small size, dark in ground colour, the median fuscous-brown suffusion particularly strong, and the dark markings usually very prominent. The British Museum collection series contains specimens from New Caledonia, Samoa, Port Darwin, Sidney, Rarotonga, &c. There is, however, one example from the Sherlock River, West Australia, which is small, uniformly pale ashy-grey in colour, and with slightly suffused hindwings, but otherwise with a quite European facies. Druce records it also from Fiji, New Guinea, New Hebrides, as well as New Caledonia and Western Australia (see *anteà* p. 333). The Javan examples, placed in the series of *orientalis* in the Brit. Mus. coll., are distinctly nearer to this form, whilst the Tahitian race is near but hardly to be included here (cf. *anteà* p. 333). Butler first described the New Zealand form, stating that, "if it be constant, it will certainly rank as a distinct species from *convolvuli*, being altogether smaller, darker, less tinted with rosy on the body, and with the markings on the primaries more confused." Of the New Zealand examples Hudson says that they are smaller than the average of European examples, occurring frequently in the northern portions of North Island, but becoming very rare southward of Napier and New Plymouth; in South Island, only at Nelson and Invercargill. The larvæ feed on *Convolvulus*, pupate in February and emerge in November and December. The insect appeared in great abundance in the

summer of 1879, near Ohinemutu, in the Auckland district, frequenting, at dusk, the flowers of *Œnothera biennis*; they were to be seen on the wing soon after sundown, and, on warm still evenings, literally swarmed, although they were extremely local, only being observed in the meadows on a few of the grassy slopes around the shores of Lake Rotorua. In 1882, several were caught near Auckland on the flowers of *Brugmansia*, the larvæ being abundant the same summer at Waiwera on a species of *Convolvulus* growing on the sandhills there (Buller).

ε. var. *tahitiensis*, n. ab.—Forewings of a brownish-grey ground-colour, with rather sharp black and white transverse lines. Hindwings suffused. Abdomen with the tint of the usual pink bands much weakened.

Walker notes (*E.M.M.*, xx., p. 95) that he found larvæ feeding on the Island of Eimeo in the Tahitian group, on a species of *Convolvulus* with very large leaves, on April 6th, 1883. These produced in May a moth which Walker could not distinguish from *S. convolvuli*, except in size, the insect being only about 3ins. across. He also records the capture of imagines on the same island on May 9th, and during the following eight days at Tahiti, larvæ of the latter occurring at the same time on several species of *Convolvulus* (*loc. cit.*, p. 222); on June 1st-2nd, several living pupæ were found in the patches of sweet potatoes that were being dug up for the ship, at Pitcairn Island.

ζ. var. *pseudoconvolvuli*, Schauf., "Nunquam otiosus," i., p. 15 (1870); Kirby, "Cat.," p. 690 (1892).—75mm. Somewhat similar to a small pallid *convolvuli*, the underside unicolorous grey, only slightly darker on the margin. Port Natal, 1 example (Schaufuss).

Distant says that the Transvaal examples of this species are much smaller than the European, being, on an average, only about two-thirds of the wing-expanse, but not specially pallid, nor abnormal. Some, however, expand 103mm., and leave nothing to be desired in hue; Schaufuss probably received a very small specimen that had emerged after an unusually dry season (*in litt.*).

η. var. *nigricans*, Cannaviello, "Bull. Soc. Ent. Ital.," xxxii., p. 295 (1900).—I consider this a local variety of *convolvuli*, differing from the type in that it has the posterior wings very uniformly brown-grey in tint, the three black fasciæ of these wings more marked and wider. The rose-coloured rings of the abdomen are much reduced, whilst the black ones are larger, and the line which divides the fasciæ, grey, and of such width as to cover it almost entirely. Two examples taken at Godofelassi, and Makallè, in Abyssinia (Cannaviello).

Egglaying.—The eggs are laid on the foodplant, but next to nothing is known of the details as to how and when. In 1897, at Vido, Mathew collected bindweed for some larvæ that he was rearing, and each time that he did so eggs and young larvæ were brought in with the food. Hellins notes (*E.M.M.*, v., pp. 160-161) that, on August 15th, 1868, D'Orville captured a battered ♀, the abdomen flat, but which, on dissection, was found to contain 220 well-formed eggs. On August 21st, another ♀ was dissected but the ova were quite undeveloped, merely small green gelatinous spots. Another shut up in a large box on September 8th and fed with diluted honey and sugar, laid eight eggs before the 12th and then died, her abdomen being at that time empty. Another ♀, shut up on September 10th, died without depositing any eggs, although, on dissection, the body was found to contain a quantity of eggs with shells, but not fully developed. Another on September 16th was shut up, lived five days and then appeared to be dying when she was pinned to a piece of cork on which she laid three eggs, whilst her body was found on dissection

to contain 160 well-developed eggs; these were carefully extracted. On September 26th two larvæ appeared from the eggs laid between September 8th-12th, an oval period of something less than three weeks.* None of the other eggs obtained produced larvæ. From these facts D'Orville came to the conclusion that the imago does not emerge from the pupa with ova fully developed †, but in a very unformed state, and that they become gradually matured in the body of the female—perhaps after impregnation has taken place. Hellins adds that, as the egg of *A. convolvuli* is not more than two-fifths of the size of the egg of *S. ligustri*, a ♀ with her full number (somewhat between 200 and 250) ready for extrusion, would by no means show so stout a figure as a ♀ *S. ligustri* in similar circumstances. Pode obtained eggs from a ♀ captured at Slade, near Ivybridge, on August 26th, 1887. The ♀ was enclosed in a large box and two eggs were laid on the evening of August 27th (these were preserved) and 18 on the 29th, all upon the paper bottom of the box, near together, but not in contact, being scattered over an area 18mm. long by 10mm. wide. The eggs were sent to Poulton who records that the first larva emerged on the evening of September 5th, the second on the morning of September 7th; on the 8th, examination showed that the larvæ were fully formed in the remaining ova, which appeared somewhat wrinkled. Being afraid that the larvæ would die before hatching, he placed the ova in a room with a fire in order that the moderate warmth might hasten emergence. By the next morning (9th) eleven larvæ had emerged and the remaining four appeared a few hours later, in the afternoon, thus making seventeen larvæ altogether. One of the eggs did not undergo development, but subsequently changed colour and dried up. The length of time occupied in development within the ovum was as follows: 1 larva—7 days; 1 larva—8½ days; 11 larvæ rather over 10 days; 4 larvæ rather under 11 days. Hence the development is at about the same rate as that of *S. ligustri*, which occupied 8—10 days. Hellins, as we have noted above, on D'Orville's authority, puts the time of development for *A. convolvuli* at rather less than 3 weeks.* This Poulton considers is probably a mistake (*Trans. Ent. Soc. London*, 1888, pp. 516-517). As bearing out the idea of a shorter oval period, one notes that a ♀, captured on September 14th, 1897, in Piccadilly, laid 30 eggs, of which 13 hatched on September 21st, after an oval stage of 7 days, although kept in a cold room (Bell-Marley, *Ent.*, xxxi., p. 68); whilst another ♀, taken on July 18th, 1898, at Brighton, had, by the 20th, deposited 25 eggs in confinement on *Convolvulus arvensis*, and laid 8 more on the 21st; the moth died on the 22nd and dissection of the body disclosed some hundreds of eggs, of a bright emerald-green colour and much smaller than those of *Sphinx ligustri*; the eggs hatched on July 27th and 28th, so that the egg stage lasted only 7 days (Brazenor,

* In 1859, D'Orville states that a ♀ in his possession laid a single egg, and that this produced a larva on the 12th day, at Alphington (*Zool.*, p. 6818).

† There is no doubt that this is the explanation of Newman's statement that most of the ♀s of this species that appear in the autumn are barren (*Ent.*, viii., p. 275). A high temperature and food appear to be absolutely necessary for the development of the ova. Syme dissected a ♀ bred September 15th, 1860 (*E.M.M.*, v., p. 139), and found the eggs in a very undeveloped state, and had no doubt that the ♀s wanted feeding before the ova would be developed.

Ent., xxxii., p. 16). A ♀ taken in September, 1860, at Yarmouth, is stated to have laid a few eggs (Harrison, *E.W.I.*, viii., p. 202); whilst another, caught at Northfleet, 1870, laid 5 eggs (Button, *Ent.*, v., p. 221). A ♀, caught at Christchurch, August 14th, 1885, laid four eggs (Druitt, *Ent.*, xviii., p. 259); another ♀, captured October, 1887, at Starcross, laid a number of fertile eggs that hatched in due course (Powley, *Ent.*, xx., p. 304), whilst a ♀ was found October 7th, 1886, laying her eggs on a paling at Weymouth in broad daylight, none of its foodplant being near (Cambridge, *Ent.*, xix., p. 280), another ♀ was found at Epsom, in September, 1895, which also deposited a number of eggs (Morley, *Ent.*, xxviii., p. 281).

Ovum.—Oval in shape, of a deep bluish-green colour * and thus very unlike the yellower shade of most ova of the *Sphingidae*. [Hellins describes the egg as pale green, and Poulton suggests that Hellins possibly only noted the colour when it had changed as a result of the development of the larva.] The shape is also different from that of the closely related species *(S. ligustri)*, being relatively broader. But the most peculiar point about the ovum is its extremely small size when considered in relation to that of the adult larva and the perfect insect. The two main axes of the ovum measure respectively 1·3mm. and 1·15mm., while those of the closely-allied, but much smaller, *S. ligustri* measure 1·75mm., and 1·5mm. (Poulton). I have not measurements of the egg, but I noted that it is not more than two-fifths of the size of the egg of *S. ligustri*, being decidedly small for so large a moth, and pale green in colour (Hellins). Bartel also notes the egg as "green, small in proportion to the size of the moth, scarcely as large as the egg of *Smerinthus ocellata*."

Habits of larva.—The newly-hatched larvæ eat some of the eggshell, but the quantity so eaten varies greatly. Of 14 ova examined by Poulton *(Trans. Ent. Soc. London*, 1888, pp. 515 *et seq.)* —five exhibited apertures of a size to admit of the emergence of the larva but not larger, one had been nearly half-devoured, three had been about three-fourths eaten, and five had been entirely devoured except for the small part of the undersurface by which they were fixed to the paper. Poulton states that, as soon as the newly-hatched larvæ are placed on the foodplant, they almost invariably rest on the underside of a leaf, stretched along the midrib (as in other Sphingids), the "Sphinx" attitude not being observed in this stage, and, further, that but little variation in the position taken up is to be noticed; a small number were observed stretched along the stem of the foodplant or along a leafstalk, and very occasionally upon the upperside of a leaf (and probably then only because of repeated disturbance); one larva was observed suspended by a silk thread, but the use of silk is much less frequent than in larvæ of *S. ligustri*. The following tabulation shows that the first stadium is considerably longer in the larvæ which hatched first, thus tending to an equalisation of the periods of development from the time at which the eggs were laid:

August 29th, evening, 18 ova laid. September 5th, evening, first larva hatched —3·75mm. long. September 7th, morning, second larva hatched; first larva

* There is a remarkable note (*Ent.*, vi., p. 545) by Mond, who states that a ♀, taken on September 12th, 1873, laid a good many eggs, which were, on October 3rd, very dark brown. As the usual egg-period lasts normally about seven days and the colour of the egg is green, one can only suppose that a mistake was made, or that the eggs were infertile.

5·25mm. long. September 9th, morning, 11 larvæ hatched; afternoon, 4 larvæ hatched. September 12th, first larva showing traces of approaching ecdysis. Indications of shagreen-dots noticed in first and second larvæ. September 13th, first larva showing more distinct traces, and second larva showing traces of ecdysis (indications of subdorsal line and green colour of blood noticed in first and second larvæ). September 14th, first larva 8·25mm. long when extended. Length of the 15 youngest larvæ from 7·75mm.-8·25mm. being almost at the close of the stage; subdorsal can be made out. September 17th, the first larva changed skin in morning, stage 1=11½ days; the second in afternoon, stage 1=10½ days. The youngest larvæ have now been preparing for ecdysis for some time; very uniformly of a length of 8·25mm. when extended. September 18th, 9.30 a.m., 8 had changed skin, stage 1=9 days. 10.30 a.m., 1 had changed skin, stage 1=9 days. 1.30 p.m., 2 had changed, stage 1=9½ days. 3.0 p.m., 1 had changed, stage 1=9 days. 10 p.m., 1 had changed, stage 1=9 days. September 19th, 9.25 a.m., 2 had changed, stage 1=about 9½ days.

In the second stadium, the larvæ show distinct traces of dimorphism, and Poulton, for the purpose of description, grouped the 17 larvæ that he reared into—(1) "pale" (ten), and (2) "dark" (seven), larvæ. As in the first stadium the Sphinx-like attitude was not observed, the larvæ still stretching themselves along the midrib on the undersides of the leaves, but especially along the leafstalks and stems of the foodplant. When disturbed, they were observed to wriggle from side to side and often to fall from the foodplant; they manifest very little disposition to wander, no larva having been found off the foodplant in spite of continual disturbance; the larvæ are fond of eating the leafstalks and stems as well as the leaves of the foodplant. Towards the end of the second stadium, as the skin becomes stretched, the larvæ begin to assume a somewhat glistening appearance. During the resting-period before ecdysis the ground colour becomes lighter and of a more transparent and yellowish green, the change being almost certainly due to the comparative absence of food from the digestive tract at this time. The average length of the 2nd stadium appears to be about eight days, and the variations not more than one day on each side of this. The larvæ all entered the resting-stage preceding the second moult on September 23rd-24th, and moulted between September 24th (evening) and the 27th, a difference of nearly three days between the earliest and latest in completing this ecdysis. The larvæ feed up rapidly in the 3rd stadium and after some six days prepare for the third moult, those reared by Poulton entering the resting-period between September 30th and October 4th, and moulting between October 2nd and October 7th. During the resting-period, individual larvæ measured between 22mm. and 25mm. in length. By this time, one larva had fallen behind the remainder and Poulton states that there were indications that the slow growth of this laggard was due to ill-health, for it was observed to have difficulty in getting rid of its excreta during defecation, &c. (It did not undergo its second moult till October 12th.) Poulton further observes: "It is interesting to note that the larvæ darken to a considerable extent just before changing the skin, and certain observations made at the beginning of the last stage render it probable that the air gains access to the new cuticle shortly before ecdysis. The old cuticle is probably at this time dry, and not sufficiently continuous or dense to exclude the presence of air. Just previous to the 3rd moult, too, greater variation was observable in the colour of the larvæ, and Poulton reclassified the larvæ as (1) "lightest" (the six palest and bluest), (2) "intermediate" (four), (3) "darkest" (the six darkest and yellowest), but after ecdysis many of the palest larvæ were quite dark. In the 4th stage, the larvæ are

described under the groupings just indicated, and Poulton notes that, by 11 p.m. on October 10th, the most forward larvæ entered the resting-period, and, at this time, were 40mm., 40·25mm. and 42·5mm. in length respectively, the two shorter ones in the morning having become 41.25mm. and 45mm. in length, whilst others varied between 36·5mm. and 43·3mm. The entry on the resting-period varied from October 10th-15th, and the ecdysis from October 13th-18th, the last two (excepting the laggard) moulting on the latter date. Of the 14 larvæ that fed on in the last stadium, seven were preserved. Of the others one had become adult and ceased feeding on October 27th, and was then 73mm. long when extended in walking, although already it had become somewhat contracted; another ceased feeding on the same date, a third on October 28th; on October 30th, another was walking about as if preparing for burying and was 75mm. long when comfortably extended, the remainder ceased feeding on October 31st, the longest being 85mm. long when extended. The lengths of the mature larvæ were certainly less than wild ones. Buckler describes a larva as 4 inches long, Whitaker one of $3\frac{1}{2}$ inches, none of Poulton's were much over 3 inches. Of the habits of the larvæ in the last stage, Poulton notes that it has been stated that the larvæ conceal themselves in the earth or among brown leaves during the day, and writes: "I think that this is most improbable, for I did not see the least tendency towards such habits, although I surrounded the larvæ with appropriate materials during the last stage." This idea originated with Harris, in 1775, and was perpetuated by D'Orville, who (*Zoologist*, p. 6818) records that, on October 14th, 1859, he obtained a nearly fullgrown larva of *A. convolvuli*, that was found in a potato field and was so covered with wet dirt, that he inferred that it concealed itself under ground by day and fed by night. The notion that the larva hid by day beneath the soil (*E.M.M.*, v., p. 161) was proved by Syme and Buckler to be without foundation, the former observing that the larvæ fed away continuously without attempting to bury themselves (*loc. cit.*, vii., p. 139), the latter (*Larvae*, &c., ii., p. 23) finding that the larva is quite unwilling to stay on the earth and that, when so placed, it crawled up through the *Convolvulus* which had been placed over it and took up its position as usual on the stem of the plant. It showed no disposition to wander away from its foodplant (*Convolvulus arvensis*), nor any aversion to daylight, and, although placed openly on a table for several hours a day, the larva merely moved further up the stem by slow degrees to get at the leaves in their order upon the stem. Buckler gives three or four inches as representing adequately the extent of a day's progress. As another proof of the lethargic habits of the larva, the same observer mentions that he invariably found it on the same part of the foodplant as when placed in its cage the previous evening, and he concluded also that it was not a nocturnal feeder. Throughout the day the larva feeds frequently, taking rest in the intervals, and Buckler says it does not consume much at the time. Sturt, who received 17 larvæ from Cornwall, in October, 1895, says (*Ent. Rec.*, vii., p. 226) that they were sluggish, but good feeders, seldom moving unless in search of food. When disturbed, they twisted the head sharply to one side, and it was particularly noticed, when changing their food, that they would quickly let go their foothold; in fact, they showed a decided tendency to drop

off. In a state of nature, feeding as they do on a plant so near the ground, no doubt even a heavy caterpillar might not, by dropping, suffer injury. That they avoid sunshine and hide during the day, Sturt was convinced is not the case, for they seemed to prefer feeding in the sunshine if placed there, and would feed freely by gaslight. Poulton adds (*Trans. Ent. Soc. Lond.*, 1888, pp. 548-549) that the larvæ are extremely irritable when touched, ejecting from the mouth, on the slightest provocation, large quantities of a green fluid, containing fragments of leaves. This habit, he says, is quite unknown in *Smerinthus*, *Manduca*, or *Sphinx ligustri*, except when the larvæ are excessively irritated; it is, however, well-known to occur in *Hyles euphorbiae*; the habit did not take place in the earlier larval stadia of *A. convolvuli*. When irritated, the mature larvæ curled up and remained in this position for a very long time. They were fond of drinking the drops of water which were sometimes introduced on the foodplant. They also freely ate the brown and withered leaves which were occasionally introduced when the plant became frost-bitten in late autumn. The antennæ were in a state of continual and rapid vibration. The "Sphinx-like" attitude was never observed in large larvæ; this fact is, doubtless, due to the usual horizontal position of the larva upon its foodplant, which chiefly creeps along the ground. Bartel notes (*Pal. Gross-Schmett.*, ii., p. 39) that, by day, the larva is extraordinarily skilful in concealing itself, and is found almost exclusively by country people who gather the bindweed for fodder; it would appear that, in Egypt, its mode of life is different, for Schneider has met with it repeatedly, usually by day, sitting exposed on the foodplant. Powell writes (*in litt.*): "At Hyères the larvæ are usually abundant in September and October; generally they are of the brown variety and are found feeding on a low-growing *Convolvulus*, but I have found the greenish form of larva on cultivated *Convolvulus* in gardens. One may frequently see a dozen or more larvæ in a morning when out collecting; I took several on October 12th, 1892, rushing wildly along the road." Mathew notes (*E.M.M.*, xviii., p. 96) that, on September 12th, 1878, he found a single larva in a vineyard, on a plant of *Persicaria*, at Gallipoli, which turned to a pupa in a few days and, on October 16th, produced an imago; he further records (*Ent.*, xxxi., p. 115) that, on September 17th, 1897, at Pirano on the Gulf of Trieste, while passing a fence by the side of a small patch of Indian corn, he noticed a brown-looking object near the ground upon one of the palings, partially hidden among some sprays of common bindweed which was climbing up the fence, and found it to be a large full-grown larva of *A. convolvuli*, almost the exact colour of the piece of rail upon which it was resting. Search at the time failed to produce more, but, the next day, on gathering some of the plant for food at the same place, a small larva about a week old was found. On September 20th, three more small larvæ were found at Corfu on bindweed brought in for food. On two other occasions food was obtained at Vido, and each time eggs and small larvæ were obtained. The larvæ fed up very rapidly—one found that had just hatched on September 27th had buried by October 18th, but an accident upset the earliest formed pupæ, although four were quite healthy on February 15th when the ship was at Alexandria. The same observer states (*loc.

cit., xxxiv., p. 282) that, in 1901, when he found several larvæ in the neighbourhood of Dovercourt, in potato fields, choked in places with masses of *Convolvulus arvensis*, *Polygonum aviculare* and *Chenopodium*, the larvæ often climbed the potato stems to rest, and he adds that the larvæ have, owing to this habit elsewhere, occasionally been mistaken for, and recorded as, larvæ of *Manduca atropos*. The nearness of the larvæ can usually be discovered by their frass, which is rather elongated and smaller at one end than the other, and thus differs from that of *M. atropos* which is square or brick-shaped; moreover, the frass of the latter lies in a mass under the plant upon which the larva has been feeding, whilst that of the former is found at intervals upon the ground; by following this the larva can be traced. Brazenor notes (*Ent.*, xxxii., p. 16) that the larvæ of *A. convolvuli* bear no resemblance in form, colour or behaviour to those of *Sphinx ligustri*. Contrary to the action of the latter, the larva of *A. convolvuli* would, on being touched, or even the food shaken, turn the head sharply round until it met the last segment and then drop from the plant. Mathew also further notes (*Ent.*, xxxiv., p. 283) that the larva, which is hard-feeling to the touch, when annoyed, curls itself into a ring or violently jerks itself from side to side. Bell-Marley observes (*Ent.*, xxxi., p. 67) that the young larvæ spin long webs over their food, and that, after the 1st moult, the larvæ resemble those of *S. ligustri* in miniature, only the stripes are very much paler. Hatching on September 14th, 1897, the moults of the larvæ in his possession occurred on October 14th, October 27th, November 8th, two larvæ finally going underground on December 12th and pupating on December 16th, without having undergone a 4th moult and having taking 86 days from the time of hatching to pupation. Only one pupa appears to have resulted. Comparatively few larvæ (or pupæ) have been taken at large in the British Islands. The following are the records that we have so far observed*: October 14th, 1859, nearly fullfed at Alphington (D' Orville); October 5th, 1859, near Freshwater (*Zool.*, p. 6788); October 8th, 1859, at Penzance (Hayward); 5 pupæ were found at Chatteris in early September, 1859 (Fryer); several larvæ in 1859 in the Carlisle district (Armstrong); in 1859, several pupæ dug up in potato fields in the South of England (Newman); 3 larvæ from Deal, on September 7th, 1859, imago emerged September 15th, 1860† (Syme, *Zool.*, pp. 6788, 7269); 7 larvæ, taken on small bind-

* Apparently the earliest record of rearing the imago from the larva in Britain is that by Davies [*Zool. Journ.*, v., p. 142 (1830)], who states that he obtained larvæ which in due course became pupæ, from which he reared 2 ♀s for the collection of the Portsmouth Philosophical Society, several ♂s assembling to the ♀s on their emergence, and entering the room in order to reach them.

† The only instance that we know of a larva pupating in autumn in Britain and, going over the winter as pupa, producing an imago normally the next year, is the following: "Mr. Syme exhibited a ♀ specimen at the meeting of the Ent. Soc. of London, on October 1st, 1860, which had emerged from pupa on the 15th ult., and had been produced from a larva found in a potato field at Deal, in the autumn of last year, and had remained nearly a year in the pupal state" (*Zool.*, p. 7269). This record must be read in connection with a note by Hellins (*E.M.M.*, vii., 139), which states that "Syme had three larvæ brought him on September 7th, 1859, that they went down on the 12th and 13th of the month, two producing perfect pupæ, one of which produced an imago, as far as Syme can recollect, about the end of May, 1860, the pupa having been kept in a room without a fire in it during the winter." We do not understand the difference in these two accounts of the rearing of what is evidently the same moth. Mathew notes (*in litt.*) that a pupa, which assumed this stage in the autumn of 1901, was turned out of its cocoon alive in April, 1903, but that it died directly afterwards.

weed at St. Leonard's, on September, 17th, 1863 (*Zool.*, 8893); a half-grown larva on August 23rd, 1865, at Devonport (Hayward); one on September 24th, 1872, at Mersea, left off feeding September 28th, went down on the 29th (Laver *teste* Buckler); two pupæ found in a potato field in Isle of Sheppey, in September, 1872 (Walker); a fullgrown larva found on October 14th, 1875, in Alderney, on *Convolvulus sepium* (Luff); a pupa dug on October 17th, 1876, at Birchington (Golding-Bird); a larva in August, 1877, at Hereford, pupated almost as soon as obtained (Pilley); pupa on October 31st, 1884, at Woodford (Hunt); [two larvæ August 1886, one of which pupated, the pupa was perfectly healthy August, 1887, and appeared likely to pass another winter in the pupal stage (*teste* Higgs, *Ent.*, xxi., p. 55).*] Four larvæ, at Dover, on August 14th-16th, 1894, one pupated on August 20th, from which an imago emerged October 7th, another pupated on August 17th, and an imago emerged October 5th, another pupated August 19th, the imago emerged October 10th (the 4th larva was preserved). In 1895, two larvæ were found at Dover on August 12th, one pupated on August 13th, the imago appearing September 30th, the other larva preserved, another larva was taken on August 14th, pupated August 16th, the imago appeared on October 9th. In 1897, a larva taken on August 16th, pupated August 24th, but the pupa died (Pickett, *Ent. Rec.*, xii., p. 138). Four larvæ on October 19th, 1895, and 13 more on October 24th, were sent from Port Wrinkle on Whitsand Bay, of these 5 died, 2 were given away, 10 went down for pupation from which 7 healthy pupæ were obtained. The larvæ went down between October 19th and November 17th; the pupæ were forced—one from December 3rd, an imago from which emerged December 20th, three from the 14th, of which one emerged on the 29th, another on the 30th, and the third on January 1st; one more was forced from January 12th, the imago emerging on January 29th. Two pupæ died (Sturt, *Ent. Rec.*, vii., p. 226). Two fullfed larvæ were found in October, 1895, at Wye (Theobald); two larvæ at Weymouth, one of which went down on October 3rd, 1895, the other, found on October 5th, was fullfed by October 16th (Richardson); 1 larva in August, 1898, at Weymouth, on garden convolvulus (Peachell); 1 fullgrown larva on September 1st, 1899, at Penarth (Howe); 1 fullgrown larva on September 28th, 1900, at Portland (Hyde); a larva on August 2nd, and a pupa on September 22nd, 1901, at Portland (Hyde); fullgrown larva on August 7th, 1901, on Holy Island, a pupa also was dug up on September 30th in the island (Embleton); two larvæ August 14th, 1901, on *Convolvulus arvensis*, at Maldon (Fitch); 4 larvæ on August 16th, 1 on August 17th, 8 between August 19th and September 10th, 1901, at Dovercourt, on *C. arvensis*; also 59 pupæ between August 16th and November 23rd, brought by labourers digging potatoes; from these and the larvæ only two moths were bred (Mathew); 2 larvæ on August 16th, 1901, at Elstow, these pupated on August 28th and September 2nd, 2 other larvæ taken on September 7th, pupated on the 12th, and one on September 14th which pupated on the 16th, whilst a pupa was found on October 4th; all the pupæ died (Nash); 26 larvæ, by August 19th, 1901, on the sandhills of the Lancashire coast, feeding on wild convolvulus (Grimshaw);

* We have no doubt from this record that this was an error and that the recorder did not know the larva or pupa of this species.

1 on August 19th, 1901, at Cornhill, near Dover, a second a few days later (Mathew); 2 larvæ on August 19th and 21st, 1901, at Boxworth, on bindweed (Thornhill); 13 larvæ between August 20th and September 3rd, 1901, at Sudbury; also a pupa on August 22nd (Ransom); 3 larvæ on August 21st, 1901, at Kirklebride, and 2 on September 10th-11th, 1901, at Dunbar (Evans); a fullfed larva on August 23rd, 1901, at Angmering, which pupated in due course (Dollman); 1 fullgrown larva on August 23rd, another on August 26th, also a pupa a few days later at King's Lynn (Atmore); a larva on August 24th, 1901, at Guestling (Bloomfield); 1 fullfed on August 26th, 1901, at Chilwell, this buried on August 29th (Pearson); 1 nearly fullgrown larva on August 28th, 1901, at Dawlish (Main); a larva on August 28th, 1901, at Mucking (Burrows); larva on August 28th, 1901, at Ilford, pupated September 5th (Adams); 5 fullgrown larvæ at Monkton, nr. Roystone, between August 30th and September 2nd, 1901, on *Convolvulus arvensis* (Whitaker); 50 larvæ in August and September, 1901, at Seaton Sluice, on *Convulvulus sepium*, of which, all but one went down for pupation, (Proudlock *teste* Robson); 4 larvæ and 1 pupa between August 20th-29th, 1901, at Hadleigh (Whittle); 1 nearly fullfed at end of August, 1901, in Hayling Island (May); 5 larvæ and several pupæ August and September, 1901, at Bournemouth (Crallan); a pupa taken in a garden at Folkestone in August, 1901, produced an imago on September 20th, in a warm room (Hills, *Ent. Rec.*, xiii., p. 335); a pupa on September 4th, 1901, on the Sussex coast, among *C. arvensis* and *C. sepium* (Frohawk); a pupa dug at Haddenham on September 19th (Barton); 2 larvæ and 3 pupæ from September 6th-20th, 1901, at Ringwood, from two of which imagines emerged October 3rd and 14th (Fowler).

Duration of larval life and rate of growth.—In his excellent account of this species, Poulton details (*Trans. Ent. Soc. London*, 1888, pp. 550 *et seq.*) the average duration of the egg stage and each of the larval stadia, and gives a comparison of the growth of the larva at the end of each stadium. His tabulation works out as follows:

DURATION OF TIME FOR		LENGTH OF LARVA	
Development in the egg ..	10 days	Newly hatched	3·75mm.
1st larval stadium	$9\frac{1}{2}$ days	At end of 1st larval stadium	8·25mm.
2nd larval stadium	8 days	At end of 2nd larval stadium	14·0mm.
3rd larval stadium	$8\frac{1}{2}$ days	At end of 3rd larval stadium	24·0mm.
4th larval stadium	12 days	At end of 4th larval stadium	41·0mm.
5th larval stadium	13 days	At end of 5th larval stadium	80·0mm.

Poulton says: "Each of these figures was estimated from the data given at the end of each stage (*loc. cit.*). The whole period of larval life may be taken as extending from about September 8th to about October 29th—a period of 51 days. It appears probable that an unusually short development in the egg only causes a corresponding protraction of the first stage; and it is also probable that larvæ emerge from the egg with very varying amounts of unassimilated nutriment, and that those with the smaller amounts have carried on the process of assimilation to a greater extent in the egg itself, and, therefore, emerge at a comparatively late period, while, con-

versely, those with the larger amounts hatch comparatively early, but are compelled to continue the process outside the egg. Hence the length of the first stage would be correspondingly greater in the latter case, but no effect would be produced upon the later stages. It is probable that the length of larval life (exhibited by these particular individuals) was unusually great, and that the larva becomes mature at an earlier period in the localities in which it breeds regularly. The closely allied *S. ligustri* has a larval period of about five weeks, and the same is true of *Smerinthus ocellatus*. In this country, the leaves of the foodplant are extensively killed by frost during a period which corresponds with the last part of the larval life—a time when growth is especially rapid. I could only get food by obtaining it here and there in many places, and my larvæ would certainly have perished of starvation in the wild state. In addition to this, the larval life would have been somewhat longer in the latter state, for the larvæ were kept indoors at a comparatively high temperature. They were fed so carefully throughout, and the food was kept so fresh, that there was no protraction of life owing to the causes which frequently operate upon larvæ in captivity. Temperature has a very great influence upon the length of larval life, as I have especially observed in the case of *Smerinthus ocellatus* during the past cold summer (1888). It, therefore, seems probable that this larva pupates comparatively rarely in this country, and that, in warmer countries, the larval life is shorter, approaching that of *Sphinx ligustri*."

LARVA.—* *First stadium (newly-hatched)*: The body very pale yellow, with a slight greenish tinge on the anterior part of some larvæ; the head of a very pale, brownish-yellow colour and of rounded shape. (Hellins describes the larva as at first white.) The caudal horn, which from the first is held very nearly upright, is quite pale and transparent immediately after leaving the egg, but it very soon darkens and becomes black. [It is very surprising that the deep colouring-matter of the ova should produce so little effect upon these pale and colourless larvæ.] The newly-hatched larva when extended is 3·75mm. in length, and there is very little individual variation. [The newly-hatched larvæ of *S. ligustri* were found to be 5·25mm. in length.]. Shortly after the first meal the larvæ became green, and, by September 12th, they had acquired a glistening appearance quite unlike anything I had hitherto seen in the larvæ of *Sphingidæ*. On September 13th, microscopic examination of the two oldest larvæ showed that the colour had extended to the blood, which was of a pale yellowish-green colour in the claspers and other parts remote from the digestive tract. The lateral longitudinal tracheal vessel can be distinctly seen with a lens, upon each side of the transparent larva, and the dorsal vessel and Malpighian tubules are also plainly visible. The dorsal vessel forms a very distinct feature throughout the stage. The fact that the green colour of the larvæ is, at this stage, chiefly dependent upon

* If we had to criticise (*anteà*, pp. 307-310) adversely Poulton s faulty description of the 1st stadium of the larva of *Sphinx ligustri*, it is only fair to say that, although no structural details are given, his account of the development of the markings of the larvæ of *Agrius convolvuli* has no equal for completeness in the description of any other Sphingid species known to us. Without his work, this section of our life-history of *A. convolvuli* would have been practically blank.

the contents of the digestive tract, was well seen on September 14th, when a single one, out of the 15 younger larvæ, was found at the end of a shoot, where it had been eating the young yellowish leaves. This larva was of a much paler green than all the others which had been eating the older darker leaves. The caudal horn is not so long as in the larva of *S. ligustri*; it tapers very slightly from base to apex, and it is held so as to nearly make a right angle with the line of the back. During this stage, it is characterised by a very slight curve, with the concavity directed anteriorly, conferring upon it a very unusual appearance, for the curve in the horn of other *Sphingidae*, and in the two last stages of this species, is in the opposite direction. [For the general appearance of the horn see pl. xv., fig. 2 (× 5·8).] The bifidity of the horn varies immensely, and this is probably true of the younger stages of all other Sphingid larvæ, although they have not been examined with equal care. These extreme individual differences are to be expected because of the vestigial nature of the part in question. [The larva that hatched on September 7th, possessed the most strongly marked fork: it is shown from the front in pl. xv., fig. 3 (× 50).] The terminal bristles are seen to be stout, and each ends in a very slight knob, while the rest of the horn (of which only the upper part is shown in detail in fig. 3) is clothed with thickly crowded minute short hairs, each springing from a tubercular base. The structure is thus very different from that of the next two stages in which the horn presents a thorny appearance, due to the presence of a much smaller number of far larger hairs and tubercles. (Compare pl. xv., figs. 3 and 4, with 9 and 16.) [I am now able to state that the caudal horn of *Sphinx ligustri*, in the first stage, is similar to that just described, and bears the same relation to the stages which immediately follow.] One of the younger larvæ also possessed a deeply-notched horn, but not so pronounced as that represented in fig. 3. The ends of all the horns of other larvæ were much like that shown in fig. 4 (× 50), some having a rather deeper notch. The dark colour of the horn slightly suffuses the larval surface around the base of this structure. The well-known tubercles and bristles are distinct from the very first, having the arrangement shown in fig. 2 (× 5·8). Each abdominal segment, from the 1st-7th, bears five of these prominent structures upon each side, and there are a large number of them upon the indistinctly separated segments posterior to the 7th abdominal. The arrangement upon this part can be seen in figs. 2 and 6, and upon the thoracic segments in figs. 2 and 5. There are at first no other shagreen-tubercles * upon the larva, but at the end of the stage, just before the resting-period, there is an indistinct appearance of these structures. A fairly high power only shows that the green larval surface is mottled with white, and does not support the view that tubercles are present. It is probable that the effect is due to the partially-formed shagreen-dots of the next stage, showing through the transparent skin. The head is thinly covered with short hairs (figs. 2 and 5). The subdorsal line is certainly absent at first, but there is no doubt about its

* Poulton still calls the primary tubercles and their setæ shagreen-tubercles (see our criticism *anteà* p. 309, footnote). True shagreen-tubercles are secondary structures.

appearance at the end of the stage. It is very difficult to see clearly because of the glistening larval surface, and its borders are very ill-defined. It is possible that this feature also belongs to the next stage and is only seen through the skin. Knowing that these larvæ subsequently become brown, I was very interested to find that five of them (the first hatched, and four of the fifteen younger larvæ) possessed a well-marked brown area, bounded by tubercles bearing bristles, upon the dorsal surface of the prothorax (see fig. 5), another brown triangular area, similarly bounded, on the anal flap, and a brown quadrangular area on each side of the anus (fig. 6). The anal claspers were also brown. These marks were present through the whole stage; the posterior patches were of a much darker brown colour than that upon the prothorax. The tubercles and bristles were, of course, similarly arranged in the larvæ without the brown areas. [The prothoracic area is, I feel sure, the homologue of the hard plate which occupies this position in wood-boring and burrowing larvæ, in Tortricids, &c. This plate is evidently a very ancient feature of the lepidopterous larva. Traces of it can, I believe, be found almost universally at one or other of the larval stages. It will be again referred to in this ontogeny.] These five larvæ were isolated in order to determine whether the differences would be increased in succeeding stages. *First stadium (mature):* About 8·25mm. in length when extended although the larvæ can stretch to 8·6mm.; their length was very uniform. In the resting-period before ecydsis the larva is cylindrical in shape, long and narrow, with a very uniform diameter, but tapering very slightly and evenly from the 8th abdominal segment to the anterior extremity; this appearance is especially well seen when the larva is somewhat contracted. *Second stadium:* Immediately after ecdysis the horn is colourless, but it deepens into black (except for the median zone) in the course of an hour or two, this is also true of the dark patches and shades * present on most of the larvæ. The head retains the rounded form, but loses it in subsequent stages. The caudal horn is held as in the last stage, but it is now very nearly straight. It is still bifid, but the fork is much smaller and less conspicuous. Its surface is now thorny, from the presence of relatively few large tubercles which terminate in bristles; a section of its length nearer the tip than the base is now white and partially transparent. The general appearance of the structure from the anterior side, is seen in pl. xv., fig. 9 (× 24·5). The larva is still green and is covered with white shagreen-dots, each terminating in a bristle, exactly as in *Smerinthus* and *Sphinx ligustri* in this stage. The subdorsal is present, but is not so conspicuous as it becomes later in the stage. All other characters present at the beginning of the stage varied greatly. The main tracheal trunk is quite visible through the whole of this stage, and the dorsal vessel still forms a very prominent dark green median line. On September 20th, when the average length of the seventeen larvæ was 10·5mm., they were all carefully compared together, with the following results:

* Poulton notes: "This stage opened with a great surprise; I had fully expected that the five larvæ which exhibited dark marks in the last stage, would still continue to be the darkest varieties in this and that the differences would even increase. To my great astonishment these five larvæ were much lighter than the others as a whole, so that the relations were completely reversed. Similar reversals occurred in the later stages."

(1). *Eleven of the larvae without dark markings in stage* 1.—Dark pigment (black in the extreme varieties, smoky in others) is now present in some of the larvæ, on the head, prothorax, thoracic legs, claspers, near the anus, and round the spiracles. The four lightest larvæ had the dark pigment only slightly developed on the claspers, thoracic legs (in one of them the claspers were free from dark pigment, and the thoracic legs comparatively pale), round the spiracles and along the lower edge of the furrow running below each lateral margin of the anal flap; from this furrow the dark colour tended to spread downwards. There was also a very slight dusky shade over the region of the ocelli in two of these larvæ. The remaining seven larvæ were much darker; in only one of them was the pigment on the head confined to the ocellar area. The darkening below the anal flap was strongly marked, and, in a few of the darkest larvæ, it extended on to the flap itself, although chiefly developed upon the edges of the latter. The previously described dark marking on the dorsal surface of the prothorax was distinct in one of the darkest larvæ and just indicated in one or two others. One of these larvæ is represented in pl. xv., fig. 7 (× 5·8).

(2). *Six of the larvae, of which five possessed the dark markings in stage* 1.—These larvæ were much lighter than those described above. Only one possessed the dark shade (and this not strongly marked) on the side of the head, other than on the ocellar area; only one (not the same larva) showed some slight indications of the prothoracic darkness which was marked in five of these larvæ in the last stage. There was a slight cloud over the ocellar area of four larvæ. The lightest of all the seventeen larvæ was included in this division; in it, the dark colour was absent from the region of the anus and the claspers, and was very slight on the thoracic legs and round the spiracles. All the larvæ except this, and one from the former division, had the dark shade more or less marked on the claspers. The transparent zone on the caudal horn was especially distinct in this division and in the lightest larvæ of the other division.

The larvæ were now (September 20th) rearranged in two new divisions, according to the presence of dark pigment in this stage. There was an obvious contrast between the seven darkest larvæ of the first division and all the others; the new division of ten light larvæ was, of course, constituted by adding the four palest of the old first division to the old second division. On September 21st, I observed the presence of a row of brown spots on each side of the larva in the light division, which possessed traces of the prothoracic darkening. There was a spot on each of the abdominal segments 1-7 (inclusive), situated just above the spiracle and below the lower margin of the subdorsal line. This marking could not have belonged to the next stage, as I thought at first, for the larva was still feeding, and continued to feed for two days. On September 22nd, the subdorsal line became much more distinct on all the largest larvæ. It had also become very broad by extending upwards, being thus gradually transitional into the broad green dorsal band. Its lower margin remaining sharply defined, it follows that the ground-colour of the body is somewhat sharply divided into a dorsal and ventral shade. The brown-spotted larva was carefully examined; it had a dusky tinge in the region of the ocelli, from which a faint cloud extended up the side of the head, there was a fair amount of dark pigment on the thoracic legs, which became red toward their extremities, on the claspers, and below, and (by this time) upon the anal flap. The 7th white stripe which terminates upwards at the base of the caudal horn, could now be just made out in its upper part, in this and most of the other larvæ. [This stripe was always the first to become conspicuous in *Sphinx ligustri* and in *Smerinthus*.] An excesssively faint brown border to this stripe was continued downwards and forwards from the 7th brown spot. Similar indistinct

borders extended from the 4th, 5th and 6th spots, but the stripes themselves could not be seen. The homology between these spots and those described upon many Smerinthid larvæ is obvious, and, hence, the fact that the brown borders are certainly connected with the spots, becomes of great importance. There will be far more evidence of this in the next stage. The faintest trace of brown spots could now be seen upon another larva of the same division, but they were so slight that their presence would not have been noticed except for the clue afforded by the former larva. The 7th spot was only represented by a darkening of the green ground colour. The seven dark larvæ were also carefully examined, and traces of one or two brown spots were, perhaps, present upon two of them, but I could not feel sure of this, the upper part of the 7th stripe, probably upon all of them. On September 23rd, the seven dark larvæ were again minutely examined, and it was noticed that the upward-extending part of the subdorsal line—in mature larvæ which had not yet entered the resting-stage before ecdysis—was distinctly divided into oblique white stripes, of which each pair tended to meet and form a V, with the backward directed apex interrupted by the dorsal line, due to the underlying dorsal vessel. In some larvæ, five distinct, oblique, white stripes could also be made out below the subdorsal, and two more very faint ones in the most strongly marked individuals. The continuity between the upper and lower sections of an oblique line, above and below the subdorsal, was obvious in two or three of the segments. Very slight traces of brown spots—often a mere darkening of the ground colour, with sometimes the faintest brownish tinge—could now be made out on most of these larvæ. Each spot was always placed just below the lower edge of the subdorsal, in such a position as to form the upper part of a dark border to the oblique white stripe, whether the stripe itself was present or not. The ten light larvæ were also examined at the same time. The brown-spotted larva was now in the resting-period. The dark pigment upon it had not undergone any further change since the last description of the larva on September 22nd. There were now distinct traces of brown borders extending from the three posterior spots, and very slight traces extending from the four others. No stripes could be seen except the upper part of the last, which was distinct. This larva, in which the spots and associated borders were developed to a far greater extent than in any of the others, was now removed to a separate cylinder, in order to test its relation to the other larvæ in the next stage. This larva is represented in outline on pl., xv., fig. 8 (× 5·8). The shagreen-tubercles are omitted, except in profile; all the dark marks represent pigment. The dark mark between the 2nd and 3rd thoracic segments probably belongs to the next stage, and is seen through the transparent cuticle. The oblique white lines above the subdorsal were less distinct in these light larvæ, but they could be made out by comparison with the more decided appearances in the other set. They were best seen by looking at the larvæ with the naked eye and from a little distance. The mature larvæ (in this stadium) were about 14mm. in length when moderately expanded, but the largest could stretch to 15mm. or even 16mm. During the resting-period the length was very

uniformly 14mm. *Third stadium :* * (I) *The ten pale larvae of stadium 2.*—Three of these larvæ were bluish-green (like the well-known tint of *Smerinthus ocellatus*, although not so bluish as the extreme varieties of the latter). One was bluish-green inclining towards intermediate. In describing these larvæ those with the smallest amount of the dark markings are, with one exception (the 10th larva) taken first.

1. The least-marked larva possessed a somewhat lighter horn than that shown in pl. xv., fig. 10 (× 3); in other respects it was similar, with the yellowish transparent zone near the tip, and the light pinkish area at the side of the base. Red spots, like those of *Smerinthus* larvæ were present; upon the 7th abdominal segment, the spot was only represented by darkened ground-colour; upon the 6th abdominal it also possessed a very faint reddish tinge, which was rather more distinct upon the spots on the other abdominal segments, although the red area was always extremely small. There was a faint dark cloud on the anal flap and a dark mark below its lateral margin. Each of the four anterior claspers possessed a dark semilunar mark. The thoracic legs were red, becoming black at the base, and the ridge to which each pair of these legs is attached, was also dark. The first and the last two spiracles were brown, the others very dark brown, producing the effect of black. There were two slight smoky patches, the one anterior, and the other posterior, to each of the spiracles; especially faint in the case of the prothoracic, and especially pronounced in the case of the 1st abdominal spiracle. Upon the head, the ocellar area was dark, and an almost imperceptible tinge spread upwards from this area over the side of the head. The subdorsal line was faint except in its anterior part ; the oblique white stripes and their borders were also faint, but distinctly visible. No traces of an 8th stripe could be made out, as in the early stages of *Smerinthus* and *Sphinx ligustri*. A faint dark tinge was present between the 2nd and 3rd thoracic segments at the spiracular level, and this, spreading outwards, formed a somewhat distinct patch on each side of the larva. This patch was separated from the prothoracic spiracle in front, and the 1st abdominal spiracle behind, by a distance which corresponded with that between the abdominal spiracles, and thus the existence of an additional spiracular patch, making a complete series with equal intervals, was suggested, as in the case of certain varieties of *Smerinthus populi* (see *Trans. Ent. Soc. Lond.*, 1885, p. 305). The ground colour was yellowish-green beneath, light bluish-green above, the demarcation being sharp, and taking place at the subdorsal level, as in many larvæ of *Smerinthus ocellatus*. A mediodorsal line, somewhat darker than the adjacent ground-colour, was present.

2. The second larva was rather bluer beneath; the white stripes and their borders of dark ground-colour were very distinct, as was the whole length of the subdorsal line. The red spots were very distinct but very small, especially on the 7th abdominal segment. The anal flap was without the dark cloud, and the dark marks below it and on each of the four anterior claspers, were very faint. The thoracic legs were paler than in the last individual. Upon the head there was only a faint cloud on the ocellar area. The lateral mark between the 2nd and 3rd thoracic segments was present; the patches on each side of the spiracles were fainter and very slight, and they were entirely absent in the case of the 1st spiracle. On the other hand the 6th abdominal spiracle was dark brown, almost black.

3. The appearance of the third larva is represented in pl. xv., fig. 10 (× 3). There was a slight dark cloud upon the border to each oblique white stripe, it appears upon the border just as it enters the posterior of the two segments in which its course lies, and just above the level of the subdorsal line. The stripes and borders were less distinct than in the larva last described, but they are represented more distinctly in the figure, so that, in this respect, the appearance of the second larva is given, rather than that of the third. The red spots were much larger than in the two larvæ described above. The last spot was much fainter than the others. The head was bright yellowish-green, as in the other bluish larvæ, and as in the young bluish or whitish larvæ of *Smerinthus ocellatus*. The dim lateral shade was

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* All the individuals were healthy at the beginning of this stage, except the darkest of those described in the last stage as the division of 10 pale larvæ. This larva died on September 27th. On the 29th, all the larvæ were carefully compared and described. The larvæ remained shagreened as in *Smerinthus* and *Sphinx ligustri* although the character is not represented in the figures.

developed to the extent shown in the figure. The spiracles were like those of the second larva, but the patches were more distinct. The distinction between patch and spiracle could not be indicated on a drawing of the size of the figure. The smoky patch was very faint in the case of the prothoracic spiracle, but it tended to pass backwards, so as nearly to fuse with the patch between the second and third thoracic segments. The median dorsal line was present, as in all these larvæ. The ground colour was not quite such a whitish blue-green as in the last individual. The extremely Smerinthine appearance of these three larvæ is well shown in fig. 10.

4. The fourth larva was less decidedly bluish-green, and tended somewhat towards an intermediate variety. The horn was very black and the transparent zone was only slightly marked. The red spots were rather larger than in the larva last described, but they were otherwise similar. There was only a slight dark shade upon the anal flap, but below it there was much of the dark colour (more than in any of the three larvæ hitherto described), and a dark shade appeared, for the first time, at a still lower level, upon the last clasper. The patches around the spiracles were larger and darker, and the three lightest spiracles (1st and the last two) were also darker. The claspers were blacker, and a dark shade spread upwards from the semilunar mark. The dark spiracular line, extending backwards from the 1st spiracle, was more marked than in fig. 10. The thoracic legs were blacker and less red. The lateral marks on the head were very black, and there were rather faint lines in front of, and parallel with, the former. These marks were more distinctly shown in the other darker larvæ (see figs. 11, 12, 13, and 15). The subdorsal line, oblique stripes, and their borders were very much as in the 3rd larva, except that there was a distinct, although faint, dark cloud upon the borders, below the red spots; this character is plainly shown in another larva represented in fig. 11.

5. The fifth larva was, like the fourth, a long way on the bluish side of au intermediate variety. The horn was very black, the light zone being small, but bright yellow in colour. The spiracles were black, except the first and last, which were dark brown; the patches surrounding them all were large, but not very dark. The red spots were large, becoming somewhat larger anteriorly. The borders to the stripes, above and behind the spots, were very faintly reddish, especially in the posterior of the two segments crossed by each border, and also in the anterior part of the anterior segment. [This arrangement is shown in a far more pronounced form in fig. 11.] This character was less distinct in the last two stripes. The other parts of the borders were distinct and of a dark green colour. The spiracular line upon the thoracic segments, and the mark between the 2nd and 3rd of these, were distinct, although not very black. The broad lateral line on the head was dark and distinct, and traces of the anterior line were also present. The subdorsal line was very indistinct except anteriorly; the stripes were fairly distinct, especially the last. The shade on the anal flap was faint and of small extent, but large and dark below it. The thoracic legs were very dark above and red below, like those of the larva last described. There was a faint subspiracular cloud, corresponding with that which was more distinct in other larvæ (figs. 11, 12, 13). There was a tendency in this and all the other larvæ towards the fusion of the posterior parts of the dark borders with the dark dorsal line.

6. The sixth larva was very similar to the last, only rather darker throughout. The traces of red borders to the stripes were somewhat more distinct. The transparent zone was very small, although bright yellow.

7. The seventh larva was a distinct yellowish-green variety. The spots were still reddish, although darker in colour than in previous larvæ; the dark parts of the borders were also of a dark reddish colour. The fusion between the dorsal line and posterior parts of the borders, had now caused the appearance of a broad dark green dorsal band. The stripes were distinct and of a yellowish-white colour. The zone on the horn was slight and dim. The spiracles were all black except the last, which was nearly so. The last red spot was small and indistinct, and the last but one was also smaller than the others. The anterior line on the head was distinct, as well as the lateral band. There was no trace of an anterior extension of the upper part of the dark borders along the upper margiu of the subdorsal line, as in other larvæ to be described below (see figs. 11, 12, 13). In all the points not specially alluded to this larva was about as dark as the one last described.

8. The eighth larva was also distinctly yellowish-green, and its appearance is indicated in fig. 12 (× 3). It was much darker than the last, and the spots were black and not red. The amount and distribution of the dark markings is sufficiently indicated in the figure. Although so different from the larvæ hitherto described, some of the varieties of the next division of larvæ, of which one is

represented in fig. 11, form a very perfect transition from this to the lighter larvæ. The very different and darker ground colour of the area above the subdorsal is very striking.

9. The ninth larva was the darkest obtained except one (the 7th of the next division); it was the larva which died September 27th.

10. The tenth larva was the one which was separated in the 2nd stage, because of the especial development of brown spots (see fig. 8). Under these circumstances it might have been expected that the larva would be among the dark varieties of the succeeding stage, but, as in other cases, the reverse took place. This larva was examined and compared September 29th; it was a distinct bluish-green variety, ranking with the 1st, 2nd and 3rd larvæ already described. The red spots were distinct, becoming larger and more distinct anteriorly, the last was far the smallest, and the last but one intermediate between this and the others. The stripes and borders were very distinct and *Smerinthus*-like, as in the 2nd larva. The subdorsal line was very distinct anteriorly. The larva was, therefore, a very light variety, and it would rank between the 2nd and 3rd of those described. On October 2nd it was again examined. There was no dark shade on the head, very little on the claspers; the thoracic legs and the horn were as in the other light varieties. There was a very slight shade on the anal claspers, and hardly any on the anal flap. The whole appearance was extremely Smerinthine. The stripes were of a bright yellowish-green colour (somewhat deep in tint as compared with other larvæ).

(II) *The seven dark larvae of stadium* 2.—Upon the whole these larvæ were somewhat darker than the ten larvæ just described, and hence the effects witnessed in the last stage have, in this case, passed on into the succeeding stage; but it will be seen that the differences are very small. As before, the bluish lighter larvæ will be described first. The larvæ were compared October 2nd.

1. A bluish-green larva, about equal to the lighter of those described. The shade upon the head was almost confined to the ocellar area, an almost imperceptible cloud extending upwards from the latter. The increase in the size of the red spots anteriorly was well seen, the last spot being very minute. The first and last two spiracles were light brown, and the surrounding patches were in all cases very small. The amount of dark colouring elsewhere was very slight, although distinctly traceable in the usual positions. There was hardly any dark pigment between the 1st and 2nd spiracles.

2 and 3. These two larvæ, although bluish-green, would rank with the 5th and 6th of the previous divisions, for there were distinct red marks upon the borders to the stripes, below the red spots, in both larvæ, and also above the spots in the 3rd larva. The 2nd larva had a slight transparent zone in the horn, and a very dark head; while the 3rd had the zone even less marked, but the head lighter. Both larvæ were fairly dark around the anus, but the flap of the 3rd was much the darker. The stripes and dark green borders were quite distinct in the 2nd, fairly so in the 3rd, larva.

4. Then followed a larva with a ground colour of an intermediate tint. (This larva is represented in fig. 11 × 3). The condition of the borders made this larva decidedly darker, for the dark red shade was not only present upon the borders above and below the red spots but, in the former locality, a dark smoky shade extended from the central red mark, stretching along the upper edge of the subdorsal line, and forming a very conspicuous feature. In addition to this, there was a highly conspicuous oblique dark patch above the subdorsal, upon each of the 2nd and 3rd thoracic segments, and upon the 1st abdominal (see figure). The degree of development of the dark markings in other parts of this larva is shown in fig. 11. This larva would be quite as dark as the 7th of the previous division, but it was not of the same distinct yellowish-green colour. The elongation of the red spots along the borders (see fig. 11) is a very interesting feature, indicating the relation of these characters to the coloured borders of *Sphingidae*. It should also be noted that the transparent zone in the horn was well-marked.

5. This larva was very similar and an intermediate variety, although with a slightly yellower tint of ground colour.

6. This larva was also an intermediate variety. In darkness it would be intermediate between the 7th and 8th of the other division. These last three larvæ were very similar, although their relative darkness is expressed by their order.

7. This was the darkest of all the larvæ in the 3rd stage. It was a yellowish-

green larva, and is represented in fig. 13 (× 3), and also in fig. 14 (× 5·25). The latter figure being larger, it has been possible to introduce the shagreen-dots, which were omitted from all the other figures of this stage. The distribution and amount of the dark markings are sufficiently indicated in the figures. The easy transition from the degree of darkness indicated in fig. 12 (the 8th larva of the last division), to that shown in fig. 13, is very clear. The larger scale of fig. 14 has permitted the representation of two of the chief tubercles, which are quite distinct upon most of the segments. These have the appearance of black points, one above and one below each spiracle except the last, in which one is above and one behind. The hairs which spring from them are long. The shagreen-tubercles are generally darker on the dark parts of the larva, *e.g.*, the horn. The head is very black, and its green ground colour has become dark, while the black markings have extended greatly. Its appearance from the front is seen in fig. 15 (× 9). The area above the subdorsal is now almost completely black, the green ground colour being chiefly traceable along the median line. Although the markings have the effect of black at a little distance, and are thus represented in the figures, a careful examination in a strong light on September 29th, showed that all the dark markings upon the borders and above the subdorsal are of a purplish-brown colour, but of so dark a shade that they appeared to be black. On October 2nd, when the larva was in the resting-period before ecdysis, this purplish tint had become more distinct, and it could now be recognised everywhere except on the darkest places, *viz.*—the horn, upon and below the anal flap, and upon the head. At this time there was also a prothoracic dorsal-plate distinctly demarcated from the surrounding surface, like that described in the 1st stadium, and shown in fig. 5. This structure also became especially distinct in the resting-period of the next stage. In the 3rd stage the plate was traversed by the subdorsal line, and hence became mottled with white upon each side, while the plate regained its black colour below the line. This appearance only became distinct during the resting-period, and is not shown in figs. 13 and 14, which were drawn at an earlier period.

The apparent black marks of the other larvæ could also be resolved into purplish-brown tints in a strong light, especially towards the end of this stage. The caudal horn is still thorny and distinctly bifid, although not so deeply or so widely notched as in the last stage. The notch was uniformly present in the larvæ. The appearance of the horn of the 3rd stage, as seen from the front, is shown in fig. 16 (× 14·5). The horn figured was one in which the transparent zone was well marked; it is quite straight, and held at the angle shown in figs. 10-13. The results of this comparison of the darkness and the shades of ground colour in this stage may be expressed in the following tabular form; the intervals between the larvæ indicate breaks in the transitional series:

	PALEST AND BLUEST.	INTERMEDIATE.	YELLOWEST AND DARKEST.
The 10 pale larvæ of the last stage	{1, 2, 10} 3* — 4 —	5 6	— — 7 — 8* — 9 — (dead)
The 7 dark larvæ of the last stage	1 — — — —	2 3	— 4* 5 6 — — — 7*
	I.	II.	III.

The larvæ with asterisks affixed were those represented in figs. 10, 11, 12, 13 (and 14). The divisions I, II, III indicate the new arrangement, which was adopted on October 2nd, after the comparison of colours. If the larvæ were arranged with reference to the shade of ground colour alone, the following series would be

obtained (omitting the 9th in the division of 10 pale larvæ):

	BLUISH-GREEN.	INTERMEDIATE.	YELLOWISH-GREEN.
The 10 pale larvæ	{1, 2, 3, 10} — 4 {5, 6}	— —	{7, 8}
The 7 dark larvæ	1 {2, 3} — —	4 {5, 6}	7

*Fourth stadium**: (I) *The six lightest and bluest larvae of the 3rd stage.*—Of these larvæ three were large (about 38mm. long) and three small, about 30mm. They are arranged in the order of relative darkness, the lightest larva being described first:

1. The lightest and greenest larva was one of the small ones mentioned above; it was painted October 10th, and is represented in pl. xvi., fig. 1 (× 2). The arrangement of the dark markings and relation to the green ground-colour is sufficiently indicated in the figure. This was the lightest of all the larvæ in the 4th stage, and it is seen to be transitional from the darker larvæ of the last stage, while it is also connected with the darker larvæ of this stage by a very complete series of gradations, the chief of which are indicated in figs. 1, 2, 3, 4, 5, of plate xvi. The larvæ were still covered with shagreen-tubercles as in *Smerinthus* and *Sphinx ligustri*; these are not shown in the figures.

2. All the five remaining larvæ were dark varieties; the least dark of these was 2, one of the small larvæ, which possessed distinct stripes and borders, together with faint traces of the green ground-colour, while the subdorsal became distinct in its anterior part. This larva is represented in plate xvi., fig. 3 (× 2), and it is seen to afford a beautiful transition towards the darker larvæ.

3. One of the larger larvæ possessed a very distinct subdorsal line, and a fairly distinct subspiracular, both these lines remaining light and contrasting strongly with the dark larval surface. The red spots could be made out plainly, but they were very dark, almost black.

4. Another of the large larvæ was similar, only the two longitudinal lines (subdorsal and subspiracular) were not so bright and distinct.

5. The third of the larger larvæ, in which the stripes and red spots were so dark that they could hardly be distinguished from the general surface of the larva. The two longitudinal lines were distinct, and of a bright yellow colour, as in plate xvi., fig. 4, which represents one of the larvæ of division III.

6. The third of the smaller larvæ was much like the last only still darker, although the stripes were much more distinct.

The difference between the 6th and the other larvæ decreased, and that between the 2nd and the others increased, subsequently, for the dark colour becomes rather less deep during growth. The real line of demarcation was, however, between the first larva and all the rest; this great difference dwarfed all the minor differences between the latter. The horn in this stage is slightly curved, and possesses the shape shown in pl. xvi., figs. 1-5. It will be noticed that the curve is now the reverse of that seen in the 1st stage. The surface is shining, although still rough, with comparatively small tubercles, which represent the far larger thorns present in the two previous stages. The colour is black, with a dark reddish-brown patch on each side of the base, especially bright in the green variety (1), and hardly present at all in the case of 4 and 5. There was a very faint

* On October 8th all the larvæ were carefully compared except the single one in division III, which was still in the 3rd stadium.

trace of the light transparent zone on the horns of 1, 3 and 4. The tip was slightly but distinctly bifid in all except 4 and 5. The spiracles were bright orange and extremely conspicuous in all the larvæ. (II) *The four intermediate larvae of the 3rd stage.*—These larvæ were of very uniform size on October 8th, being about 30mm. long. There were faint traces of a bifid termination to all the horns except that of 1 which was somewhat distorted.

1. This larva was a green variety, but not so bright or with so much of the green colour as 1 of the previous division. There was rather less green on the head and much less along the median dorsal line. The green was duller and less yellowish in tint; the dark borders were much wider and were of considerable breadth at the point where they became continuous with the black dorsal band, whereas these two dark markings were almost discontinuous in 1 of the previous division, thus nearly allowing the subdorsal line to pass between them. The transparent zone on the horn was slightly marked; there was hardly any of the reddish-brown colour at the base. This larva was carefully re-examined on October 11th, when nearly mature in this stage, and was again compared with the lightest of the previous lot (shewn in pl. xvi., fig. 1); the larva formed a beautiful but gradual transition from the latter in the direction of the darker larvæ. All the points in the comparison made above continued to hold at this later date. It was also noted that the dark spiracular band on the thoracic segments was wider, and that the horn was blacker. The oblique stripes were white.

2. A dark variety about equal to 4 of the previous lot. An exact comparison was very difficult, especially because of the change of colour during growth, and also because the darkness varied in different parts of the larvæ, so that extreme darkness in one part might be compensated by unusual lightness in another. Thus this larva retained the traces of the green ground-colour as in 2 of division I (fig. 3). Nevertheless the differences between the dark larvæ were insignificant compared with the differences between them and the green larva. There was no trace of the transparent zone on the horn.

3. A dark variety about equal to 5 of the previous division. The ground-colour was dark, but the two longitudinal stripes were very distinct, and the transparent yellow zone on the horn very conspicuous, but there was hardly any reddish-brown colour at the side of the base.

4. This larva was darker than any of the previous division. The transparent zone on the horn was slightly marked. The larva is represented in pl. xvi., fig. 5.

(III) *The six darkest larvae of the 3rd stage.*—Five of these larvæ were compared on October 8th, the 6th being still in the previous stage. The lengths of the larvæ are given below:

1. The lightest larva was an extremely interesting green variety, transitional from the 1st of the last division towards the dark varieties. It is represented in pl. xvi., fig. 2 (× 2). Although much darker than either of the other two green varieties, there was, nevertheless, a larger amount of green colour spreading from the stripes. The reddish-brown patch at the base of the horn was very distinct in this and the other four larvæ of this division. This larva was about 27mm. in length.

2. This larva was about equal to the 5th of division I. Length 36mm.

3 and 4. These larvæ were very dark, but the two longitudinal stripes were very distinct and of a bright yellow colour. The larvæ would be classified with No. 6 in division I, and their appearance is represented in pl. xvi., fig. 4. One of these larvæ exhibited no trace of a bifid extremity to the horn, which was present in all the others of this division. Length of both larvæ 36mm.

5. This larva was equally dark and with longitudinal stripes less strongly pronounced. It would be classified with the darkest larva—(4)—of division II, and may be represented by the figure of the latter larva (fig. 5). The yellow transparent zone on the horn was very distinct in this larva and 1, very slight in one of the last two larvæ, and absent from the rest. Length 30mm.

The comparison between figs. 1—5 (pl. xvi) shows the chief steps of the transition from the greenest to the darkest larvæ, but many intermediate steps are necessarily omitted. These are, however, indicated in the tabular form given below, which sum-

marises the results of the comparison made above. The real break is between the three green larvæ and all the rest, and the differences between the former far outweigh those between the latter. Hence the following classification expresses the relation between the varieties:

	GREEN VARIETIES.			DARK VARIETIES.					
Degrees of Colour	1	2	3	4	4*a*	4*b*	4*c*	4*d*	4*e*
Division I of the last stage	(1)*	—	—	(2)*	(3)	(4)	(5)	(6)	
Division II of the last stage	—	(1)	—	—	—	(2)	(3)	—	4*
Division III of the last stage	—	—	(1)*	—	—	—	(2)	(3)* (4)	(5)

The asterisks indicate the larvæ which are figured on pl. xvi. It is very curious that each of the three divisions should have produced a single green variety. In this stage, for the first time, the shade of the larvæ followed, upon the whole, the arrangement of the last stage, although the parallelism was far from being complete, as we see in the appearance of a green variety in the darkest division (III). The bright orange spiracles form a very prominent feature in this stage, together with the bright yellow longitudinal stripes in some of the dark varieties (see fig. 4). At the close of this stage, during the resting-period, the prothoracic dorsal plate became very conspicuous, the cuticle around it being thrown into wrinkles from the strain to which it was exposed, while the denser and thicker plate was able to resist the strain. Its appearance is shown in pl. xvi., fig. 11 (× 7). The plate, being darker in colour and without wrinkles, is very prominent against the surrounding cuticle. The 6th larva of division III was mature in the 3rd stadium, on October 8th; on October 10th it had entered the resting-period; on October 12th (4.30 p.m.) it had just changed its skin. The larva was that known as 8 in the division of "10 pale larvæ of the 2nd stage" (see comparison at end of 3rd stage). It is represented, in the 3rd stage, on pl. xv., fig. 12. This larva died on October 16th; it was apparently a very dark variety, but was not sufficiently advanced in the 4th stage for a safe comparison with the other dark larvæ. *Fifth stadium:* All the larvæ became dark varieties in this stage. Immediately after the change of skin the colour had not darkened into its permanent shade. Thus the head was yellow and green. The dorsal prothoracic plate, and the anal flap and horn were the lightest parts of the larva immediately after ecdysis. It is probable that this is due to the protection afforded by the thickness or density of the cuticle over these parts, including the head. The darkening of the larva being due to the action of the air, it is probable that these parts alone would be completely protected from it until after ecdysis had taken place. The shagreen-tubercles of the previous stage are very distinct before the colours have darkened, appearing as white circular areas, surrounded by a rather deeper shade of ground colour, each containing a dark point in the centre. (This

appearance is shown pl. xvi., fig. 12 (× 7), representing the 6th abdominal segment immediately after ecdysis. The areas are the scars of the old tubercles, the dark central points are the rudimentary tubercles of the 5th instar which still continue to bear minute hairs. It is probable that many of these fall off later in the stage. The explanation of the circular scar is as follows: The comparatively light purplish or yellowish ground colour, alone present after ecdysis, is subcuticular in position, being contained in the hypodermis cells. This colour is not formed in the hypodermis cells which are beneath the comparatively large shagreen-tubercles of the previous stage. The dark colour, which subsequently appears, is cuticular in position, and extends over the colourless hypodermis, and thus conceals the great majority of the circular areas. Above the subdorsal line the ground colour is at first purplish, the borders to the stripes are also purplish, deepening into blue in the centre of the darkest part, corresponding with the position of the red spot in earlier stages [pl. xvi., fig. 12 (× 7) illustrating the arrangement and tints of the ground colour, and the scars of the shagreen-dots, as seen immediately after ecdysis, in the 6th abdominal segment]. Below the subdorsal the ground colour is yellow or yellowish-green. The thoracic legs are red, black at the tip. The horn is reddish-orange at its base, yellow at the upper part and tip. The head is yellow, but the parts which will become dark, are green. The prothoracic plate is at first much swollen and green. Three of the chief tubercles are black and distinct on each side of each abdominal segment (see fig. 12, in which two of these structures are shown); the tubercles bear long and prominent hairs. This examination of the larva immediately after ecdysis is evidently of great importance, the stripes and borders bearing much resemblance to those of the larva of *Manduca (Acherontia) atropos* in the last stage, and, as hinted above, it gives the opportunity of describing the colours due to pigment in the hypodermis cells, before everything is concealed beneath the superficial pigment which is formed in the cuticle. The larvæ were compared on October 20th, when they had apparently taken their permanent colour. There were, nevertheless, some few modifications due to slight changes which happened subsequently. The larvæ examined were:

1. *Division I of the earlier stages* (omitting the green variety of the last stage).—Of the five larvæ, three were dark like those last described, one of them being even darker, and possessing no indication of the oblique stripes, while the subdorsal was very slightly represented by a single spot on each segment. (This larva is represented on pl. xvi., fig. 10.) The two other dark larvæ possessed traces of the oblique stripes like the two larvæ of division II. The two remaining larvæ were lighter varieties, one of them with the subdorsal distinct for its whole length and expanded into a distinct spot at the anterior margin of each segment. Above it was a dorsal line upon each side, similarly expanded into spots; traces of stripes were present. (This larva is represented on pl. xvi., fig. 7.) The other larva only exhibited traces of the dorsal line and the subdorsal was less distinct; the stripes were similar.

2. *Division II of the early stages* (omitting the green variety of the last stage).—All three larvæ were very dark, the ground colour being black; the subdorsal line was represented by a single spot on the anterior margin of each segment, except anteriorly, where it was continuous; the subspiracular line was light and prominent. All three were very similar, except for slight differences in the size and distinctness of the light subdorsal spots, and in the distance over which the subdorsal formed a continuous stripe. There were very faint traces

of oblique stripes on two of the larvæ. The length varied from 50mm. to 65mm.

3. *Division III of the earlier stages* (omitting two larvæ, one having died in the 4th stage, while the green variety was put in spirits shortly after ecdysis; it is quite clear that the latter larva would have been dark).—All four larvæ were dark varieties; three being very dark indeed, with small spots representing the subdorsal line and hardly any trace of the oblique stripes. In one case these spots were almost absent, and there was no trace of the stripes. The fourth larva was remarkable, in that the subdorsal line and stripes were distinct, the former for its whole length, although the larva was a dark variety. (This latter larva is represented in pl. xvi., fig. 8.)

4. *Division IV* (including the two greenest varieties of the last stage).—These two larvæ were separated from their divisions shortly after ecdysis, on October 17th. The darker variety was the larva removed from division II. The latter larva was dark; the subdorsal being only represented posteriorly by a single large distinct spot upon each side of each segment, but it was continuous upon the thoracic segments. Traces of the stripes were present. (This larva is represented on pl. xvi., fig. 9.) The other larva was light, and (at this time) intermediate between the two lightest larvæ of division I. (It is represented in pl. xvi., fig. 6.) Both these larvæ were preserved by Lord Walsingham and are now in the Natural History Museum, South Kensington, where they are available for reference.

The fourteen larvæ were arranged in the order of relative darkness as follows:—

Degrees of Colour.	The darkest larvæ.	Equally black with more distinct subdorsal spots and traces of stripes.	Equally black but subdorsal continuous, and stripes distinct.	Ground colour browner and less dark.	Ground colour still browner and less dark.	Ground colour still browner and lighter; the dorsal lines distinct.
Division II ..	1	1 1°				
Division I ..	1*	1 1°		1		1*
Division IV ..		1*			1*	
Division III ..	1	1 1°	1*			

The larvæ marked ° possessed a light-coloured and extremely prominent subspiracular line; in the others, this line varied from a light brown colour, almost like the marked larvæ, up to a distinct brown tint; but this feature was always extremely distinct, and formed by far the most prominent marking of the larvæ. The horn is now curved and shining like that of *Sphinx ligustri* in the last stage. The prothoracic dorsal plate is very distinct and polished (see figures). The larvæ were re-compared on October 25th, when the four largest were 80mm.—90mm. in length, varying with the degree to which they were stretched. The relative darkness was the same as on October 20th, except in the case of the two lightest larvæ of which the position was now the reverse of that previously noted. The lightest larva was, therefore, the lighter of the two in division IV (pl. xvi., fig. 6), while the next lightest larva was the lightest of division I (pl. xvi., fig. 7). This relative position is indicated in the order of the figures on pl. xvi., but the arrangement of the previously-given tabular form requires

* These represent the larvæ figured pl. xvi., figs. 6-10.

to be modified in this respect, if it is to represent the order of the mature larvæ (Poulton). *Adult larva* [Larva sent September 14th, 1901, by Dr. Sharp, from Holy Island, Northumberland, said to have been 4 days without food, appeared to be anxious to go down for pupation and is somewhat dull in its colouring. Of its true legs five had had the last (tarsal) joint amputated, in one the amputated portion still adhered by a shred of tissue. These wounds, which had bled seriously, no doubt made any hope of raising the insect rather faint]: It is a nice example otherwise of the green form of the larva, the colours are dirty green, with black stripes, no other colour, except the basal half of the horn and spiracles, which are orange. Length, $3\frac{1}{2}$ins. The head has two black vertical stripes on each side, a broad marginal one, and a narrow anterior one, the latter central between the marginal one and the middle suture. The spiracles are really a dirty orange or dull brown, but are in a patch of black, which leads one to say at first, spiracles black. There is a trace of black mark at the incisions on the spiracular line, more pronounced on the first two abdominal segments, and on the thoracic it continues the black spiracular mark and enlarges that round the black spiracle. On the mesothorax and on each segment to abdominal segment 7, there is subdorsally a black mark at the anterior margin of the segment on each side, largest on the mesothorax, where it encroaches on the 2nd subsegment, elsewhere it is confined to the first subsegment. On abdominal segments 1 and 2 is a black patch directly above spiracle and half way between it and subdorsal patch as to level, it is on the 4th subsegment, each segment after 1st abdominal having apparently 9 subsegments. These lower marks are, in fact, the anterior ends, the subdorsal marks being the posterior, of the diagonal black stripes, which, in this specimen, are complete as to the posterior five on the right side and as to six on the left; beneath them, at their anterior ends, the green is paler and looks as if a yellow mark occurred beneath the black stripe, possibly in this specimen before its colour faded, probably in brighter coloured examples. On the 8th abdominal segment the stripes proceed backward to the base of the horn, which somewhat confuses the subsegmentation which is so distinct in the anterior abdominal segments. The horn is short, thick, curved, $\frac{5}{16}$in. long, rather more than half of it basally is orange, with regularly disposed rough (hair-bearing) points darker, the further portion is black. The subsegments are very finely wrinkled and have some very small rough points, but no spicules or hairs, the legs are black. The subspiracular flange is very marked, rising nearly to level of spiracle at front of segments much below it posteriorly, beneath it are two other less fully developed ridges. Anal plate green (yellow margin?) thinly covered with rough points that are hardly spicules. Prothoracic plate green, with a black shading at anterior margin, centrally (Chapman). Buckler describes the fullgrown larva (*Larvae Brit. Butts. and Moths*, ii., pp. 22-26); Newman describes a larva obtained at Alderney (*Entom.*, viii., pp. 272-4); Doubleday gives a translation of Boisduval's description (*Ent.*, vi., pp. 561-2); Embleton also describes the same larva as that described above by Chapman (*E.M.M.*, xxxvii., p. 297), and Brazenor described one (*Ent.*, xxxii., pp. 15-16).

VARIATION OF LARVA.—Boisduval says that the larvæ of this

species vary greatly, not only in the markings but also in the ground colour, which is sometimes of a bright green, sometimes of a dark green, very often of a light brown, and sometimes of a dark brown. Among the green individuals the following varieties have been observed:

(1). Of a bright green with two rows of black spots along the back, and seven oblique white lateral stripes, the horn fawn-coloured on the upper side and black beneath. (2). Of a dark green, with two black lines along the back and seven oblique stripes of the same colour on the sides. (3). Green, with six longitudinal rows of black or brown spots, and the head and horn ferruginous.

The brown individuals, he notes, are equally variable. The principal forms are:

(1). Olive-brown, with two black lines along the back, and seven oblique stripes of the same colour on the sides; the head and the 1st segment of the body of a ferruginous-red, a large white spot upon the sides of each segment. (2). The three anterior segments with whitish longitudinal lines. (3). Entirely brown with the back darker than the sides.

Besides these six forms, intermediate ones are not rare and sometimes almost the whole of the body is intersected by a multitude of very fine black lines. The same author states that the caudal horn is either fawn above and black beneath, or ferruginous, or of a rusty-red. The larvæ that Sturt obtained from Port Wrinkle varied in size and colour very much. He describes (*Ent. Rec.*, vii., p. 226):

(1). The brown form (in those just changed into the last skin), varying from almost black, with continuous white stripes along the side, to two (full-fed), which were of a pale putty-colour with very faint markings. (2). The green form varying from a rather deeper tint than that of *Sphinx ligustri*, with oblique black stripes bordered with white, to a very washy shade, with the black stripes broken up into three dots of pale brown.

Bartel writes (*Pal. Gross-Schmett.*, ii., p. 38): "A very dark form of the larva corresponding with the black aberration of *Acherontia atropos*, has been observed in numbers locally, *e.g.*, 23 examples from Hungary are lying before me. It occurs both black-grey with a faint brownish line, and also quite black, and has an obscure dorsal tinge, but even this is wanting in half the examples before me. On each side of the dorsum a yellow stripe runs from the head to the horn, where the two run together or terminate in a large yellow or reddish spot. These stripes are much inclined to disappear and sometimes approach nearly to vanishing." Mathew notes (*Entom.*, xxxiv., p. 283) the following forms as occurring among the examples obtained in 1901, at Dovercourt:

(1). Bright apple-green, with narrow black lines between the skin-folds; oblique stripes bright yellowish-green; head green, with black stripes each side of the cheeks; horn orange-red, tipped with black. (2). As in 1, but with a subdorsal row of square-shaped black spots, and a large black blotch above each spiracle. (3). Apple-green, with the oblique stripes broadly bordered above by purplish-black, the stripes nearly meeting over the back, and those on the last two segments running up to the base of the caudal horn. (4). The brown variety, as figured by Buckler, but difficult to describe.

But the interesting facts of the variation of the larvæ of this species have already been detailed at length in our quotation of Poulton's description of the various forms (*anteà* pp. 346-360). In the third stadium of the larva, he finds a distinct resemblance to the Amorphid larvæ—(1) In the variability of the ground colour, (2) in

the variable development of the red spots, and (3) in the relations of the latter to the borders of the stripes. The association of a bluish-green ground colour with the absence of pigment and a general Smerinthine appearance, is very striking, when compared with the dark markings and greater peculiarity of the yellowish larvæ. Nevertheless, there is a very gradual transition from the one type to the other, and this can be clearly seen in the series of four larvæ represented in figs. 10-13, although there were other larvæ intermediate between some of these. The stages of this transition, he considers, probably represent the steps by which the dark variety * has arisen from the green one. These stages are:

(1). A green *Smerinthus*-like larva with a red spot on the border to each stripe.

(2). The increase in the dark part of the borders both in size and in depth of tint. The red spots elongate along the border, and at the same time distinct dark reddish patches appear above and below the elongating spots. Dark patches and bands appear and increase elsewhere.

(3). The borders become still darker, and their upper part tends to spread anteriorly along the upper edge of the subdorsal, thus shutting off a band of dorsal ground colour.

(4). The ground colour thus shut off first becomes much darker than the rest by a deepening in the tint of the ground-colour itself, finally nearly black, from the gradual intrusion of the black borders of the band.

The further continuation of this process of darkening will be seen in the following stage. It must be remembered that the purplish-brown colour of the markings connected with the borders, together with the elongation of the red spots and the red colour of the additional dark marks on the borders, seems to clearly support Weismann's conclusions that the red spots are connected with the coloured borders to the stripes. These facts also serve to connect together *Sphinx* and *Smerinthus* in a most interesting manner (Poulton, *Trans. Ent. Soc. London*, 1888, pp. 535-536). Poulton further details the variation in the 4th and 5th stadia and submits a most interesting series of figures (*loc. cit.*, pl. xv-xvi) which give one a very clear idea of the evolution of the dark forms; the five figures (pl. xvi., figs. 1-5) of larvæ at the end of the 4th stadium are particularly interesting, whilst those in the 5th stadium (figs. 6-10) show a certain amount of uniformity in adult coloration, that explains why green adults are comparatively rarely, in some districts, seen in nature. The chief variations are in the shade of ground colour which passes from brown to black, in the prominence of the subdorsal, sub-spiracular and oblique stripes and their borders, the subdorsal being often represented by a single spot on each segment posterior to the first abdominal. In the lightest varieties there is a dorsal stripe above the subdorsal, also tending to form spots (above the subdorsal spots indicated in figs. 6-7). The alternation of light and dark varieties of the larvæ of *A. convolvuli* in the successive stages was very remarkable and very marked in many larvæ in all the stages except the last in which all the larvæ became dark varieties. Poulton also gives (*loc. cit.*, p. 552) a diagram showing in a graphic manner the way in which the larvæ oscillated backwards and forwards, between the dark and light varieties during the successive stages. He says: "It must be understood that the dark

* Mathew notes that none of the larvæ that he found in the Mediterranean district, in 1897, assumed their brown coats until after the last change of skin (*Ent.*, xxxi., p. 115).

varieties of stage 1 do not contrast with the light varieties of the same stage in the same marked manner as the two varieties of stage 4 contrast together; nevertheless, the two varieties of the former were very different in this respect, and we should have expected that the darker larvæ exhibited traces of the darkness which became more manifest in later stages. So also we might well have supposed that the single larva which exhibited marked indications of the dark borders in stage 2, would have been among the number of those in which the character was principally developed in the next stage instead of among those in which it was least developed. It is well known that the green form of these larvæ often persists into the last stage. Thus I was assured that this variety is commoner than the other in the Canary Islands and in Madeira. In the larvæ above-described it has been seen that three individuals retained the green ground-colour in the 4th stage, while all the others lost it. Under these circumstances, it might well have been supposed that the larvæ would exhibit the power of variable protective resemblance which so many species are now known to possess. Thus *Rumia crataegata* can be rendered brown or greenish; while greater or less variation in the depth of the brown ground colour can be caused in *Crocallis elinguaria*, *Ennomos angularia*, *Selenia lunaria*, *Boarmia rhomboidaria*, *B. roboraria*, *Catocala sponsa;* and variations in the green colour of *Smerinthus ocellatus* and *Sphinx ligustri*. Other instances occur, and this power is doubtless very widely spread among larvæ. It is, however, certain that *S. convolvuli* does not possess this power in any marked degree, and it is probably entirely wanting. My larvæ were fed in glass cylinders placed upon white plates, and the food was always kept green and fresh. Only in the last stage were brown surroundings (earth and dead leaves) introduced, in order to test the opinion that the larvæ conceal themselves. The complete absence of brown surroundings in the earlier stages would have produced light brown or green individuals of nearly all the species above-mentioned, and yet the *convolvuli* larvæ became exceptionally dark. It is, therefore, probable that the predominance of dark varieties in one locality, and green in another, is due to the ordinary operation of natural selection upon the two forms of a dimorphic species, tending to exterminate a relatively larger number of the variety which harmonises less with the surroundings in each locality" (*Trans. Ent. Soc. London*, 1888, pp. 551-553). Burrows notes (*Ent. Rec.*, xiii., p. 306) a larva, from Mucking, of a bright, pale green colour, vertical lines white, horn orange, and spiracles orange ringed with black. Anal flap and anal prolegs yellow. Every segment transversely lined narrowly in black, corresponding with the sub-segmental divisions. Five larvæ—3 brown and 2 green—taken wild in 1901, at Monkton, are described in the *E.M.M.*, xxxvii., pp. 257-258. A larva with an entire absence of oblique lateral stripes is described by Newman (*Entom.*, viii., pp. 272-274). Pearson notes the capture of a larva at Chilwell, which had no black markings except a large black spot round the spiracles and stripes down the face; the general colour being dull apple-green, the horn reddish with a black tip.

PUPARIUM.—Sturt, who reared this species successfully in 1895,

says *(Ent. Rec.*, vii., p. 226) that the larvæ buried to a depth of about 8 inches, though the pot was a large one and they could have gone down at least another 4ins. They formed particularly large earthen cavities, in which were the pupæ—remarkably active, very soft and delicate-looking and of a pale shining reddish-brown colour. Proudlock states that the puparium consists of a large smooth cavity made in the earth from a depth of 7ins. to 12ins. Mathew says *(in litt.)*: "The fullfed larva buries itself 3 or 4 inches below the surface of the ground, and there constructs a large chamber or cocoon similar to that of *Sphinx ligustri* or *Manduca atropos*. The sides are coated with a silky or glutinous secretion which, when dry, becomes hard and brittle. One moth was found to have emerged from the pupa and had died in the puparium, having been unable to force its way through, possibly from the earth in the breeding-cage having become too dry." Bell-Marley notes *(Ent.*, xxxi., p. 68) two puparia, made on December 12th, 1897, one so thin that it fell to pieces when touched, the other very thick * like that of *Manduca atropos*.

PUPA.—[My pupæ of *A. convolvuli* are all dead and only one is a fairly good one and that has the segments rather contracted, so that I cannot go into many details of the pupa with much confidence as to accuracy.] The pupa is about 60mm. in length, flattened in front in the thoracic region, but without any S curve. The labrum is quite to the front, though the frons just dorsal to it by something less than a millimètre projects as a rounded eminence, but with a shallow dip between the two. The frons, labrum, and first part of the maxillæ are in a line, which is not transverse by a dip ventrally of 17°; this line is about 5mm. long of which 3·5mm. are maxillæ; the maxillæ then curve ventrally and proceed directly backwards until 15mm. from their origin when they make a curl towards the pupa and then forwards for 7·5mm. touching the pupa and usually being soldered to it for 4mm. of this, ending somewhat bulbously. The trunk or horn thus formed is rather more than 2mm. wide, rather less in thickness, the round smooth bulbous end being about 2·5mm. in diameter; basally it is also slightly thick. The anterior margin being set back to the labrum, there is about 3mm. free as it were anteriorly, whilst the posterior surface is still masked in the origin of the maxillæ between the cheeks, which run down beside it parallel to each other for about 4·5mm.; the margins then turn directly outwards, curving under the eyes for 5mm. to reach the antennæ, the margin of the maxillæ following the cheeks for nearly 4mm., the rest being occupied by 1st leg. There is a very narrow spindle of 1st femur against maxilla at from 9mm. to 14mm. from front of pupa. The other measurements given in table below as well as these, are from the only fair specimen I have, which may or may not be an average one. It is, I fancy, rather below average in size, and has the free segments contracted. These measurements show the pupa to have little or no flattening; it is not, however, cylindrical. An axial line would come to the surface in front near the base of the antennæ, and 2·5mm. dorsal to the most prominent front of the pupa, the dorsal line from

* We suspect from this description that these remarks are based on insufficient data; the puparium of *M. atropos* is most thin and brittle (see *posteà*).

MEASUREMENTS AT	DISTANCE FROM FRONT OF PUPA AT	TRANSVERSE DIAMETER AT	ANTERO-POSTERIOR DIAMETER AT	
			To line of front of pupa.	To projection of horn.
Prominence in front of eye	2·0mm.	8·5mm.	7·0mm.	10·0mm.
Base of 1st leg	6·0 ,,	10·0 ,,	10·0 ,,	14·5 ,,
1st spiracle	7·0 ,,	12·0 ,,	11·0 ,,	16·0 ,,
Prominence of wing-base	12·0 ,,	13·0 ,,	12·5 ,,	18·0 ,,
Prominence at end of 1st tibia				
Posterior margin metathorax, end of antennæ	17·0 ,,	13·5 ,,	14·0 ,,	
End of 1st leg = centre 1st abdominal	20·0 ,,	13·0 ,,	15·0 ,,	
Centre 2nd abdominal	23·5 ,,	13·7 ,,	15·0 ,,	
End of 2nd leg = top 3rd abdominal	27·0 ,,	15·0 ,,	15·0 ,,	
Dorsal prominence 4th abdominal	31·0 ,,	15·7 ,,	15·0 ,,	
End of 4th = dorsal margin	32·0 ,,			
End of ventral margin of wing and maxillæ	34·0 ,,	15·0 ,,	15·8 ,,	
Dorsal prominence of 5th abdominal	37·0 ,,	15·0 ,,	14·0 ,,	
Dorsal prominence of 6th abdominal	41·0 ,,	13·0 ,,	13·0 ,,	
Dorsal prominence of 7th abdominal	47·0 ,,	11·0 ,,	10·8 ,,	
Dorsal prominence of 8th abdominal	49·0 ,,	8·0 ,,	8·0 ,,	
Base of anal spike	52·0 ,,	3·3 ,,	2·7 ,,	
End of pupa	55·0 ,,			

the top of the mesothorax curving down to this point; the ventral line (of maxilla from horn to end) would be nearest this axis opposite mesothorax, receding from it both forwards and backwards, or, in other words, a straight line from base of maxilla-horn to the most prominent point over middle of 4th abdominal, would have the pupal surface 1mm. distant from it opposite metathorax and 0·5mm. at end of wings.

Of other irregularities, the dorsal line sinks a little at metathorax, and, laterally from this, a hollow deepens, till it becomes nearly 2mm. below the level of a continuous surface, just where the hindwings cross the 1st abdominal segment, and continues as a slight hollow into the forewings. The prothorax has also a triangular hollow in front of the 1st spiracle so that the rest of it, seen dorsally, looks like a square piece marked off 3·5mm. long × 7mm. wide. The glazed eye is a rather broad crescent of smooth polished surface, without very definite alteration of the areas about it, its convexity points about 20° ventral of anteriorly. Really the great rounded cheeks, forming a large boss on either side in front of the glazed eye, look more like the eyes, and are no doubt provided to afford space for the development of the imaginal eyes. The ends of the 1st tibiæ afford very decided elevations, and the 2nd leg is separated from the head by about 3mm. Sculpturing: The labrum is not very clearly marked off from the front, and has a small tubercle or two towards its margin. The head is finely wrinkled especially on the prominences, but its general effect is of being polished. The maxilla-horn has a fine double ridge at suture, and is transversely ribbed, the ridges are closer basally, where most prominent, they are about two to a millimètre and each of these double, as if corresponding to actual maxillary

structure; the bulbous extremity is smooth and polished, as is the remainder of the maxillæ. The legs are transversely wrinkled, but the wrinkles are so smooth and flattened that they are quite polished. The antennæ have transverse lines marking the segments, about 63 in number. Apically the segments are polished, thence basally they have first a point at the centre of the distal margin, whilst to this is gradually added a rough point or two and some fine longitudinal ridges along the distal margin. The prothorax has a central suture that almost looks functional; the wrinklings radiate from the centre of each half, and are flat and polished. The mesothorax presents no trace of suture, but there are the usual smooth depressed lines (marking off patagia ?); the wrinklings are transverse, absolutely so across the middle line, except for two apparent centres towards the hind margin—anastomosing and broken into islets laterally, all very low, smooth and flat, but sufficient to prevent the surface being described simply as polished. The wing-bases are equally polished, the wrinklings larger, flatter, and more irregular, with one distinct little round tubercle, about opposite the middle of the antenna and 2mm. from it. The wings are smooth, polished, the wrinkling being obscured and as if rubbed out; the nervures stand up as rounded ridges, the demarcation of Poulton's line is also very obscure, but quite determinable. The metathorax has a central ridge and a callosity* on either side nearly 4mm. long. It is formed of very fine closely packed ridges, that may be margins of circular pits crushed together. It is of a much finer texture than that of *Manduca atropos*. Outside this the segment is polished, like paper or cloth badly smoothed out rather than wrinkled. The hindwings just show Poulton's line, and do not quite reach to the spiracle on the 3rd abdominal segment. The abdominal segments show more or less of an impressed dorsal line or groove, the anterior ones some subsegmentation, a broad anterior ridge, three narrower ones and the intersegmental one posteriorly. The first of these exists on nearly all the segments and is very special in

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* In connection with the callosities on the pupæ of the higher true Sphinges (including *Manduca*), it may be noted that the imagines of these possess, on the thorax, a remarkable and special crest or tuft of scales, that does not appear to be present in other branches of Sphingides in which the pupal callosity is absent. This tuft is well seen in both *A. convolvuli* and *M. atropos*. In *A. convolvuli*, where the thoracic scales adjoin the abdominal, are two eye-like spots, which might at first be supposed to belong to the abdomen, since the forward pink abdominal stripe is lateral to them, rather than behind them. The scales of these eye-spots stand up above those of the abdomen as a definite raised margin or crest. They often present a complete black ring, with centrally grey scales like those of the thoracic disc. It is, however, more usual for the centre to be continuous with the thoracic disc, the posterior black border (often containing a few white and pink scales) is, however, always well-marked and always stands up well above the adjacent abdominal scales. It is this black border that arises from the metathorax, just from the area corresponding with the pupal callosity, as may be easily seen by removing the central grey portion which arises from the mesothorax. At first sight, looking at the pupa and the imago together, one would take the white eye-spot with its central grey pupil and outer and anterior black margin to correspond with the pupal callosity, this is not so, however, only the posterior black margin is metathoracic, and this, no doubt, has the same form as the pupal callosity, dwindling centrally, wide laterally, where it terminates abruptly. Being still in the dark as to the use of the eye-spot in the imago or of the pupal callosity, it is only possible to note the curious coincidence, without asserting that they have any causal association.

its sculpturing; a combination of pits with longitudinal wrinkling, not regular enough to say the pits are in rows down the furrows of the wrinklings, but with some such tendency, especially on the 3rd segment. This would appear to be a very similar development to the callosities of the metathorax. The rest of the segment is much less strongly marked and has both pits and wrinkles, but not so definitely related to each other. In places, as subdorsally on abdominal segment 3, the wrinklings have a flowing combed look and vary much in direction; ventrally 4, 5 and 6 are very smooth and polished, showing, however, the same wrinklings and pits as if nearly polished away; 7 and the following segments are well pitted ventrally. The slit of the 1st spiracle has the usual posterior lip, dark, smooth and projecting well forwards; just within the anterior lip is a row of very fine shining points or spicules; the slit is about 3mm. long; the abdominal spiracles are rather wide slits with sharp raised margins in an oval area, which is at the bottom of a hollow, more marked on the latter segments. The scars of prolegs are slightly depressed, smooth, with the wrinklings puckered to them as usual, so far as the nearly effete sculpturing here can be made out. There is a little pit (5 or 6 times as wide as the pits of the surface sculpture), inside and posterior to the scar in some specimens, as well as another outside it and a little more forward (larval tubercles?). The prespiracular flanges of 5, 6 and 7 are somewhat complex. They are 4mm. in length, their ventral end level with that of the spiracle and fully 1mm. in front of it. The surface passing forward from the spiracle, instead of curving inward to the suture, maintains the full width of the segment, or rather more to the first ridge of the flange. This ridge is sharp, and the surface in front of it passes directly inwards (in a transverse plane) for about 1mm.; thence the segment continues its normal curvature, but is occupied first by two (smaller) sharp transverse ridges, returning into each other at the ends and with a hollow between them due to the height of the ridges. In front of these again are two more ridges, that are little, if at all, raised, but are (rather perhaps than ridges) the margins of a rather deep hollow that lies between them. These are practically identical on all three segments, but larger and more marked on 5, least so on 7. The caudal horn scar is, as usual, variable; a small smooth area with pits round it, smaller the nearer they are to it, and so giving a radiating effect, seems normal. In one specimen, the smooth area is larger, and there is an actual radiation of raised ridges. The anal spike varies much in size and boldness in my few specimens. Seen dorsally, the regular conical tapering of 8, 9 and 10 is continued to end of horn; seen laterally, the end of 10 is truncate for its ventral half and the spike, rising from the dorsal half, proceeds directly backwards, so that its apex is in line with nearly the centre of its base; both ventrally and dorsally there is a curve (concavity ventral). In two specimens its length is—in one 4mm., in the other 2mm. It finishes (not in a bifid point but) with two quite distinct minute points; the dorsal wrinkling is coarse, basally longitudinal, for the rest very labyrinthine, ventrally less coarse, labyrinthine tending to be longitudinal. The anal scar is wide posteriorly, narrowing forward, a slight eminence on either side, longitudinally folded; the male tubercles are well raised,

occupy a nearly circular area of a diameter about the same as the width of the 9th segment, but about a $\frac{1}{4}$ of their width encroaches on 10 and by so much leaves the anterior border of 9. The posterior border of 8 is, however, sinuate to correspond with them. The female area obliterates the segmental divisions of 8, 9 and 10 in middle line. The posterior half of 8 and the anterior half of 9, over this area, are very smooth; at the anterior angle of this area is a minute pore, with lines leading to it, suggesting that it really belongs to 8. A hardly discernible pore exists near posterior border of 9, with appearance of belonging to 10. From the smooth area proceed fine raised striæ, merging into the surrounding sculpturing, *viz.*—pits, except towards anal scar. The sculpturing of the prothorax, when viewing the pupal skin as a transparent object, consists of paler lines of sulci breaking the surface up into separate plates, here and there with complicated dendritic branches; there are no pits, and the hair-points, with minute hairs, perhaps about ·04mm. long, are rather numerous, 16 being counted on one side only, but are without any definite arrangement. The prothoracic lip of the 1st spiracle is clothed with short spicules, looking like a short comb when a row of them is got in profile. They are about ·04mm. to ·05mm. long, ·01mm. broad and are about 40 to a millimètre when they can be got into view as a continuous row parallel with the spiracular opening; there are perhaps 10 to 12 rows of them, or might be so described, except that they are placed a little too irregularly to be described as in rows. On the mesothorax, the nature of the sculpturing is identical with that on prothorax but no hair-points are detected, the broad lip or plate over the 1st spiracle has a very minutely rough surface of rounded shagreen-points. The metathorax is also apparently without hair-points. The callosities present a somewhat labyrinthine set of narrow raised walls looking dark, owing to the thickness of their chitin, the marginal wall being fairly continuous as a boundary. On the 2nd, 3rd and 4th abdominal segments dorsally, the subsegments seem distinct to the number of 5, of which the 4th and 5th are perhaps again subdivided; the divisions are pale sulci that are more than those of the sculptural wrinklings, but can hardly be called sutures. The first subsegment contains many large pits, of the type that is characteristic of Sphinges (and *Manduca*), *viz.*, a raised dark margin, with the margins finely crenulated, the centre much paler (very thin) and with shading radiating to the centre from the crenulations. Each side of the 2nd subsegment has a dark point beside the dorsal line, with a median sulcus that traverses the first subsegment passing back to the 3rd and separating them. The pits in the 2nd and following subsegments are only about one-fifth the diameter of those on the 1st. The head presents several hair-points on the labrum and basal to it, but none over the vertex or in the antenna-basal region are detected. On the remaining abdominal segments, hairs are rare except just anterior to the spiracles and in the deep trough in front of the spiracular flange. The pits are very large along the front of the margins and mainly of the special Sphingid type (Chapman). The pupa measured $2\frac{11}{16}$ins. in length, and $\frac{5}{8}$in. in diameter; its stout proboscis projected $\frac{1}{4}$in. from the body, bent downwards at a slight angle for little more than $\frac{1}{2}$in., and then

curved upwards for half the distance towards the underside of the thorax, with which it was in contact near its blunt, rounded extremity. The various parts of the imago within were all remarkably well shown, yet gently rounded off at the prominences, the wing-covers long in proportion, the anal spike short, blunt, and roughish, the proboscis delicately corrugated or ringed. Each segment of the abdomen had on the back a narrow transverse band of roughness at its beginning, the rest of the surface smooth and shining; the colour was a light rich mahogany-brown, darker on the head, thorax and proboscis, and on the last two segments, the leg-, antenna- and wing-cases being the palest portions (*Larvae Brit. Butts. and Moths*, ii., p. 26). A pupa is described by Newman (*Ent.*, viii., p. 274); another by Embleton (*E.M.M.*, xxxvii., p. 297).

FOODPLANTS.—*Convolvulus arvensis*, *C. sepium*, very rarely, *C. tricolor*, *Ipomoea coccinea* (Boisduval), *I. scandens* (Powell), endive, *Convolvulus soldanella*, but refused *C. affinis* (Bell-Marley), *Convolvulus purpureus*, in India (Chaumette), *Persicaria*, lettuce (Mathew), *Ipomoea batatas*, *Zygophyllum fabago*, *Phaseolus maximus*, in Java (Bartel), *Mirabilis jalapa*, cultivated species of *Ipomoea* (Donckier), *Batata edulis* (Grabham), *Impatiens noli-me-tangere* (*teste* Newman), *Colia* (Swinhoe), scarlet-runners (Nash, *Ent.*, xxxv., p. 172).

HABITAT.—The moth may be found anywhere from sea-level to great elevations on the mountains, from the plains and mountains of South Africa and Australia, and the tropical jungles of India and the East Indies, and the islands of the Pacific to the confines of the Polar regions. In the Palæarctic area it is continuously immigrant from its subtropical haunts, becoming more or less permanently sedentary in the southern parts of this area, and finding temporary breeding-places in hot summers throughout Central Europe and Asia from the British Islands to the northern parts of Japan. These temporary habitats are very varied, *e.g.*, Treitschke notes (*Die Schmett.*, x., p. 139) that he found the larvæ feeding gregariously on *C. arvensis* in a vineyard. Boisduval says that, in France, the larva is rather common, feeding especially on *Convolvulus arvensis* in fields of potatoes and kidney-beans, sometimes also on *C. sepium*, and in gardens on *C. tricolor* and *Ipomoea coccinea*. At Autun, Constant says the larvæ frequent fields of potatoes in which *Convolvulus arvensis* grows freely, and that, upon lifting the plants, the larvæ are to be found resting beneath them. Powell writes that, at Hyères, the species is found mostly on waste ground, and in gardens where *Convolvulus arvensis* grows, but also frequents (both as larva and imago), a species of *Convolvulus* with a large white flower, that is cultivated in gardens, and whose flowers open only in the evening. He adds that "the moths themselves are very common indeed, resting on railings and fences in the early morning; so abundant indeed, that I collect them to use as food for my lizards." Mathew says that, in Madeira, the species is common in gardens, the larvæ feeding on all sorts of *Convolvulus*, lettuce and other garden plants, whilst, at Gallipoli, he found larvæ on *Persicaria* in vineyards, whilst, in the Pacific Islands, at various dates between 1882-4, the larvæ were frequently found feeding upon a species of *Convolvulus* which grew in masses on the beach, just above high-water mark. Potato-fields, where *Convolvulus arvensis* grows, appear to be the most favoured haunts in Britain of this

larva. Walker mentions (*E.M.M.*, ix., p. 162) two pupæ found in a potato-field in the Isle of Sheppey; Mathew says (*Entom.*, xxxiv., p. 282) that, in 1901, at Dovercourt, between August 16th and September 10th, the larvæ were found in potato-fields where the land was foul and the potatoes choked in places with masses of *Convolvulus arvensis*, *Polygonum aviculare* and *Chenopodium*. He also adds (*in litt.*) that between August 16th and November 23rd, 59 pupæ were brought to him by labourers digging potatoes, and that, whilst many of the larvæ were found upon the potato-haulms, others were found upon the ground between the rows of potatoes. Richardson (*E.M.M.*, xxxi., p. 280) had larvæ brought from the potato-patches in allotment gardens, where *Convolvulus arvensis* was a common weed, near Weymouth. Fitch records larvæ on August 14th, 1901, in a potato-field where *Convolvulus arvensis* was abundant (*Ent.*, xxxiv., p. 254). Frohawk notes (*loc. cit.*, p. 295) pupæ on September 4th on the Sussex coast, also in a potato-field overgrown with *Convolvulus arvensis* and *Convolvulus sepium*, and Barton (*loc. cit.*, p. 313) found one near Haddenham on September 19th, in a potato-field where *Convolvulus arvensis* was growing freely; Hyde notes larvæ and pupæ at Portland (*loc. cit.*, p. 314) also in a potato-field; and Crallan several pupæ at Bournemouth, in gardens, chiefly among potatoes (*loc. cit.*, p. 314), but May records one (*loc. cit.*, p. 314) amongst the stubble of an oat-field, with bindweed common in the surrounding hedges, on Hayling Island. Robson notes (*loc. cit.*, p. 358) over 50 taken in a hedge overgrown with *Convolvulus sepium* in Northumberland by one collector. Newman records (*Ent.*, viii., p. 274) a pupa dug up in a potato-field at Deptford; Golding-Bird writes (*Ent.*, x., p. 19) that a pupa was dug October 17th, 1876, at Birchington in a potato-field in which *Convolvulus* grew. Other records are: One brought with some larvæ of *M. atropos* at Essex, another from a garden-hedge overgrown with *Convolvulus sepium*, on which the larva had probably been feeding (Doubleday); larvæ found in 1901, at Boxworth on bindweed, growing in a field of tares, oats, &c., grown for making silage (Thornhill); larvæ found at King's Lynn, on August 23rd-26th, 1901, and a pupa a few days later in a potato-field (Atmore); two fullfed larvæ in October, 1895, at Wye, in the potato-patches and allotment gardens where *Convolvulus* was growing (Theobald); several larvæ found at Monkton, in 1901, at the bottom of a rail by the side of a field which, for 200 yards, was thickly overgrown with *Convolvulus arvensis* (Whitaker).

Habits.—It is most difficult to state shortly the habits of this species, which extends throughout the whole of the Old World and the Pacific Islands. It has a marvellous flight, and is, undoubtedly, a migrant, flies by day and at dusk, the latter, however, being undoubtedly its most active period. In the daytime it is especially fond of resting, with its wings closed back over its body, on posts and palings, at a short distance from the ground, the colours being highly protective, its tints sometimes harmonizing with the weathered posts and palings in a most perfect manner. We ourselves saw a ♀ resting on an old post, at a height of almost 6000ft. just below the La Meije glacier, in such a manner that was highly protective. When paired, Gadeau de Kerville notes (*Bull. Soc. Ent. Fr.*, 1901, pp. 77-78) that the two moths (♂ and ♀) arrange themselves in line, their heads in opposite directions, that they usually select a place, the colour of which

is very similar to that of their wings, and since they are quite immovable at this time they are exceedingly well hidden from their enemies. A figure of two moths paired is given (*loc. cit.*, p. 78, fig. 1). The males give out a very perceptible odour of musk which may have some attraction for the opposite sex (*E.M.M.*, v., p. 206). In the Vaudois mountains, in Piedmont, in 1901, the species was exceedingly abundant, large numbers being observed, the species being frequently seen on the wing in the daytime when they were more wary, active, and difficult of approach than at dusk when they sucked the nectar from the flowers of a large *Salvia*, particularly abundant round Bobbie. On August 13th, between Bobbie and Au Pra, a specimen was observed in full activity feeding at 4.30 p.m., and another on the mountains directly south of Bobbie, at 12.30 noon, on August 15th, the weather being dull, whilst on the 17th, on the mountain-path leading from Au Pra to the Col de la Croix, at an elevation of considerably over 6000ft., a fine ♂ flew straight at me and was brought down with a swift stroke that had to be executed almost before there was time to think. Its flight in the daytime was particularly bird-like, and, on the rough ground a short distance above Bobbie, up the Pellice Valley, we observed no fewer than five examples hovering at one time, well within the area of a couple of square yards, with the wings repeatedly drawn up at a somewhat sharp angle over the body, and then suddenly dropped and spread forward. Others have noticed its day-flying habits, *e.g.*, Mengelbir took an imago in bright sunshine at St. Moritz; Briggs notes (*in litt.*) 2 specimens taken at Lynmouth in 1901, between 11 a.m. and 1 p.m.; Goss that a ♂ was taken flying in the morning sunshine near Surbiton, on August 24th, 1901; Hadfield records two flying at noon at Newark; Sutton notes a specimen flying on September 6th, 1887, during the daytime in Battersea Park Road, and records one as coming to some flowers held in the hand in broad daylight in 1887, at Salcombe. Of its remarkable flight at dusk many authors have enthusiastically written. Barrett notes (*E.M.M.*, xxiv., p. 102): "The movements of this species resemble, in ease and grace, those of a swallow. There is something wonderfully lovely in their manner of glancing from flower to flower, or skimming round the beds. By moving gently, with little perceptible movement towards them, it is easy to watch them for 10 minutes at a time, sometimes within a few inches, examining flower after flower, then circling round or gliding to another part of the bed, hovering about 2 inches from each flower, and probing its nectary with a proboscis from 3 to 4 inches long. The petunias and verbenas get a share of attention, as also occasionally the neighbouring geraniums, and even the long tubular flowers of a large species of *Datura* are not entirely overlooked, but not one of these plants approaches in attractiveness to the *Nicotiana*, to which the moths always return and about which they spend most of their time. The slightest sudden movement alarms them and causes an instantaneous retreat, but, as long as we move gradually and smoothly, they seem to disregard us, and a lighted lantern is actually an object of curiosity. It is most curious to see one of these moths, on the approach of the light, leave the flowers and hover in front of it, then rise higher, pause in front of one's face with uplifted wings . . . then pass with a loud hum close to one's ear, and return as though satisfied to the flowers. This species does not hold itself bound

by the crepuscular habits of its family . . . and they may be taken from 7.30 p.m. until midnight, and the state of the weather, if not too cold, affects them but little. One night, when six were taken, was beautifully fine with bright moonlight; another—when seven or eight were seen and five taken—was exceedingly wet and stormy. Certainly rough weather is no great obstacle to them, they only seem to be rendered more careless of danger by the rough blowing about of the flowers, and there can be little doubt that they are attracted a long distance by the rich perfume carried away by gusts of wind." For its twilight flight, it appears most regularly at about the same time on each evening, and Robertson says that "they begin to appear from 6.30 p.m.-7 p.m., but are then more difficult to catch; and are more easily taken between 9 p.m. and 10 p.m., when they will fly within a yard or two of the lamp without fear; the latest capture was made at about 11.30 p.m., but the gardener saw one in broad daylight at 3 p.m., hovering at the flowers of *Nicotiana*. The insect appears to be long-lived for I kept a ♀ alive for more than six weeks in the hope of getting ova, but she only laid 4 eggs before she died." Hewett also notes that they are more easily captured later in the evening when they are really feeding. Our own experience has been that the moths when they first visit the flowers towards dusk, about 8.30 p.m. (in Piedmont), are readily startled and difficult of approach, and Kidner states (*Ent. Rec.*, viii., p. 229) that the insect is sometimes very shy, that it will start off in a moment at the sound of a voice, and one that was being watched as it hovered over flowers darted away on the church bells ringing, not to appear again. Biggs also writes (*Entom.*, viii., p. 275) that he considered the insect shy, easily startled, and not seeming to have much partiality for light, and that the imagines invariably receded from it when it was turned on them, that they flew in the most brilliant moonshine; and that most of the specimens captured in 1875 were ♀s, but that several examined contained no eggs. Edgell notes (*Entom.*, xix., p. 321) that, besides the twilight flight of these moths, they came, between September 12th and October 8th, 1886, again to the flowers just before the moon rose, the latest noticed on the wing being at 11 p.m., the whir of the wings being very audible; they came, he says, every night, neither cold nor wind seem to affect them, and one was literally blown into a bed of phlox by the hot wind of October 1st. No male was noticed till September 20th, all the earlier captures being ♀s. Allen writes (*Entom.*, xix., p. 18): "The sound made by the rapid vibration of the wings is very perceptible, and the flight excels even that of *S. stellatarum*. With its prodigious size is combined ease of movement, the graceful manner in which it coils and uncoils its long proboscis, the lightness with which it floats from flower to flower, ever and anon poising itself to extract the nectar and then darting off in a rapid but somewhat irregular flight, sometimes to a considerable height, perhaps to return to the same flower-bed, is simply delightful. This species commences its flight before daylight has departed, and appears to be fearless of moonlight." Douglas obtained 29 examples in September, 1901, at Sherborne, at *Nicotiana affinis*, the moths appearing exactly at the same time after sunset each night, the

males much scarcer than the females—6 out of 19. Hodge says that several were taken at Ilfracombe at the latter end of September, 1898, hovering over flowers of *Nicotiana;* they came down each night with the regularity of clockwork at 6.30 p.m., and variation in the light did not seem to affect them at all; on one evening as many as thirty were seen flying round the tobacco plants at one time. Cotton adds that many were seen and taken at Minehead in September, 1901, all appearing at *N. affinis* between 6.15 p.m. and 7.0 p.m. Boswell notes (*Ent.*, ix., p. 257) that, in 1875, in the Orkneys, the species flew from 8 p.m.-9 p.m., but, on going out one morning, at 1 a.m., the whir of the moth was heard, and, on lighting a lantern, four were caught in a few minutes. Farr records them as being on the wing as late as midnight at Beccles. Daws also notes one coming to light after midnight at Paul, and James says that he has taken them from 9.30 p.m.-11.0 p.m., and that moonlight apparently makes no difference to their flight. Edmunds records two on flight in the early morning of August 22nd, 1887, at Windsor. It is a thorough nectar-loving insect haunting many different species of flowers, of which *Nicotiana affinis* is probably the most attractive; Longstaff notes two moths actually fighting for access to a flower of this plant when held in the hand at Morthoe, in 1901 (*E.M.M.*, xxxvii., p. 298), and had also previously recorded (*loc. cit.*, xxxiv., p. 278) one sucking nectar from a flower of the same plant, whilst held in his hand in 1898. We ourselves found it most abundant in the Vaudois mountains, in Piedmont, in 1901, at the flowers of a giant *Salvia*. Powell says that, at Hyères, they abound some years in August and early September at the flowers of honeysuckle, convolvulus and petunias, and he adds that, in 1902, a lady returning from the seaside to the town with a bunch of flowers of *Pancratium maritimum* in her hand, was followed by quite a cloud of imagines of this species, that fed from the blossoms that she held in her hand. Moeschler gives *Lonicera* and *Œnothera biennis* as being most attractive in Upper Lusatia; Seriziat says that, at Collo, the species is most frequently attracted by flowers of *Pancratium maritimum*, and Reid asserts that they were so abundant on August 18th, 1887, and following days, about 8 p.m., at a bed of petunias at Eretat that the flowers seemed almost alive with them, but flowers of *Œnothera missogenensis* are chosen at Clevedon (Mason), of *Œnothera biennis*, at Sevenoaks, the proboscis being well dusted with the yellow pollen (Meldola), of petunias and pink geraniums, as well as *Nicotiana*, at Chingford (Cooper), of petunias at Portland (Walker), and at Cobham, between 6.30 p.m. and 8 p.m. (Ridley), also at Ipswich (Fison), at Buckland, near Dover (Stonestreet), at Wannock (Pearson), and at Stapleton (Harding), of honeysuckle at Aylesbury (Greene), at Bremhill (Eddrup), at Fyvie (Reid), at Carlisle (Day), at Newbury (Beales), at phlox at Corsemalzie (Gordon), at the Bridge of Allan (Wingate), at Chale (Irving), at Darlington (Law), at Lower Clapton, at 9 p.m. (Gaviller), at honeysuckle and single pheasant's-eye pinks at Swanbister (Boswell), at *Lilium auratum* at Hammersmith (Cowan), at Footscray (Williams), and at Douglas (Mackonochie), at Marvel of Peru (*Mirabilis jalapa*), at Lee (Bower), at Hackney (Wright), at West Ham (Biggs), at Walthamstow (Jobson), at

Delphinium (Cubitt), carnations at Dublin (Birchall), at verbenas * (Goodall), at scarlet and pink geraniums as well as petunias in the Isle of Wight (Fereday), at geraniums and petunias at Freshwater (Hodges), especially partial to the rose-coloured varieties of bedding geraniums, also attracted by flowers of the different varieties of *Althea frutex*, rhododendrons and weigeleas (Mason), especially fond of white petunias at Buckland (Stonestreet), of jessamine at Taunton (Rowlinson), of gladiolus at Wolsingham (Backhouse), in 1887, at Morthoe, the imagines would not look at verbenas and petunias, but showed a great partiality for the more gorgeous flowers of *Gladiolus* (Longstaff), at sweet peas and phlox at Panton (Raynor), over *Pentstemon* bloom at Starcross on a moonlight night (Powley). Bartel notes *Dianthus*, *Saponaria*, *Epilobium*, *Lonicera*, *Convolvulus*, *Nicotiana*, *Petunia*, *Phlox*, *Betonica*, *Verbena* and *Mirabilis jalapa* as the flowers most frequented by the species on the Continent. McRae states (*Ent.*, xviii., p. 296) that, in 1875, when the species was in great abundance in the Bournemouth district, he found sugared bouquets of flowers, consisting chiefly of honeysuckle, pale-coloured geraniums, and petunias to be the most attractive bait. White and pale-coloured flowers are the most attractive, possibly on account of their greater conspicuousness at night; one is astonished, however, that McRae describes the flight as perfectly noiseless, and he further adds that he "suspects the moths do not pair until after hybernation." We have no notion of a scrap of evidence tending to make us suppose that the imagines do hybernate. Donovan, on the other hand, captured the species commonly at Glandore in 1889, and notes them as making a loud buzzing sound in their quick flight over the flowers of *N. affinis* (see also *anteà*, p. 372). The moth does not appear to have the power to utter any sound like that made by *Manduca atropos*, although Blaber notes (*Ent.*, xix., p. 179) that he was informed by a lady, who killed a specimen of *A. convolvuli* with chloroform, that it uttered loud squeaks and other distinct sounds, apparently of discomfiture. We suspect this is not correct. The insect is sometimes attracted in large numbers to light; in mid-August, 1901, the imagines were to be seen every morning in large numbers lying dead beneath the electric lamps in the streets of Turin; in the middle of August, 1897, several flew into the lighted rooms of the hotel at Susa, and at the end of July, 1900, a fine specimen flew into a lighted room at Larche, where we were staying. It is also recorded at electric light at Pörtschach (Wagner), at Berne (Benteli), at Zürich (Nägeli), at Aix-les-Bains (Agassiz), at Davos-Platz (Sellon), and in Britain, at Taunton (Farrant), near Cheltenham (Trye), at Hammersmith (Bird), at Farnham (Lewcock), at Norwich (Tillyard), at Maldon (Bentall), at Stratford and Ilford (Murray), at Paul (Daws), at Brentwood (Raynor), at Burgess Hill (Dollman), at Eastbourne (Adkin), at Forest Gate (Harrison), at Gravesend

* Newman repeats (*Ent.*, iv., p. 148), apparently in good faith, a statement, by Goodall, from *The Field*, that he frequently saw, in 1868, at one time more than a score skimming over a bed of common garden valerian; and that "while the moths were busy on the wing the caterpillars of the same species, full 3½ins. long, and 2½ins. in girth, were feeding on the leaves below." This is an excellent illustration of how records of observations, not made, get into print.

(Jennings), at Brighton (Meaden), and at Norwich (Thouless). Nor does rain seem to prevent their flight, for Rollason notes that two appeared at dusk, at Truro, on September 22nd, 1901, in torrents of rain at the flowers, and Schultz states *(Illus. Zeits. für Ent.*, iv., p. 208) that, whereas *Eumorpha elpenor*, *Theretra porcellus* and *Sphinx ligustri* only comes to flowers and sugar on mild nights, *A. convolvuli* also comes, even if in small numbers, on cool windy nights, and even if there be rain. The migration of this species is accepted by all well-informed lepidopterists. Its sudden appearance in different years over vast areas, the specimens in good, bad and indifferent conditions, in districts where not a specimen has been seen for some time hitherto, is probably the most important factor on which this opinion has been based. Williams records *(Ent. Wk. Int.*, vi., p. 163) a specimen that flew on board a vessel in the middle of the Bristol Channel, and was caught by one of the sailors, on August 12th, 1859. Bold notes *(E.M.M.*, v., p. 172) that a fine specimen was taken on board the steamer "Lord Raglan" on September 29th, 1868, when she was 5 miles from Tynemouth, a second also fluttering around the light of a sailing vessel which was making for the Tyne, and at a considerable distance from the land; Eales found one floating on the Tyne, near South Shields, on September 13th, 1871 *(E.M.M.*, viii., p. 111), and Robson says that they are often taken on fishing-boats at sea at night off the Durham coast at rest, whilst Lawson states (Porritt's *List of Yorks. Lep.*, p. 17) that, at Bridlington, the species is frequently taken off the sails of shipping out at sea. Perkins records one *(Ent. Wk. Int.*, x., p. 202) taken on a boat moored a little way up the Tyne; and Webb another (*E.M.M.*, xxxi., p. 268) that flew on board a smack in the North Sea, 40 miles from land, towards the end of August, 1895. West writes *(Ent.*, x., p. 300) that, on October 6th, 1876, an example of *A. convolvuli* alighted on one of the Dublin Steam Packet Company's steamers when some miles off the Irish coast. Frere records one captured, in 1887, on the seashore at Cromarty (*Ent.*, xx., p. 303), Freeman the same year picked one out of the river, near Ipswich *(loc. cit.)*. Cordeaux says *(Nat.*, August, 1884) that, some years since, many were washed up by the waves on the coast between Spurn and Kilnsea, having doubtless perished in the crossing; Burgess-Sopp notes one captured on a fishing-boat at Hoylake, on September 30th, 1901 Dutton records one captured on the sail of a barge in the river Foss, at York, and Donovan notes (*E.M.M.*, xxii., p. 134) that, on September 22nd, 1885, a living example was found floating on the sea in Glandore Harbour, a second seen a week later similarly floating on the water in the harbour. Coupin is noted *(L'Amateur de Papillons)*, as stating that *A. convolvuli* migrates to Europe from Algeria. The years in which the species has been recorded as exceptionally abundant in Britain are 1846, 1857, 1858, 1859, 1868, 1876, 1885, 1887, 1895, 1901. It has often been asserted that the autumnal ♀ specimens of this species and of *M. atropos* are barren, or that they have the eggs in an undeveloped state, but this is a normal condition for these (and probably all usually migrating Sphingids), the eggs being developed after pairing has taken place and when the ♀s have done considerable feeding, nor will they lay without this feeding, as witness Corbin's record *(Ent.*, vi., p. 520) that he obtained a pairing on October 4th, 1869, but that the ♀ deposited no eggs although kept for

some time. There is abundant evidence that the late moths are killed off by cold without having deposited their eggs, and that they are exterminated every winter following their appearance in our country; but there is no evidence whatever in support of Robson's statement (*Young Nat.*, iii., p. 267) that "the species hybernates as an imago and reappears in June." As tending to prove its migrating habits, Boswell states that the species is sometimes abundant (*e.g.*, 1875) in the Orkneys, but that no *Convolvulus* grows there, for, though Neill gives *C. arvensis* as an Orkney plant, no one has found it there since. As bearing on the question of the immigration of our British examples we have two very definite sets of facts, illustrated excellently by the specimens captured in 1885 and 1901 respectively,both years in which they appeared in this country in great abundance. In 1885, the species appeared suddenly in August and continued on into September, and were in no way preceded by the finding of larvæ or pupæ in this country, nor by any early (June or July) imagines; these August and September imagines were, therefore, possibly direct immigrants from more southern climes and not bred in this country. This view is supported by the facts that, on August 14th, 1885, Druitt caught a ♀ at Christchurch that laid him 4 eggs, a most unusual proceeding for late, and undoubted British-bred, examples (*Ent.*, xviii., p. 259). In 1901, on the other hand, imagines were taken on June 2nd at Portland (*Ent.*, xxxiv., p. 314), ♀s on June 30th, July 2nd, 10th, and a ♂ on July 11th at Elstow (*Ent.*, xxxiv., p. 230), one also on July 16th at Wandsworth (*Ent.*, xxxiv., p. 230), and, by early August, larvæ were found, *e.g.*, at Portland on August 2nd (*Ent.*, xxxiv., p. 314), at Maldon on August 14th, on the sandhills of the Lancashire coast on August 19th (*loc. cit.*, p. 254), at Dovercourt from August 16th to September 10th, and at Dover, on August 19th (*loc. cit.*, p. 281), at Dawlish, on August 28th (*loc. cit.*, p. 313), at the end of August at Hayling Island and at Bournemouth (*loc. cit.*, p. 314), also in Northumberland (*loc. cit.*, p. 358), whilst pupæ were found on the Sussex coast (*loc. cit.*, p. 295), near Haddenham, on September 19th (*loc. cit.*, p. 313), at Portland, on September 22nd, and at Bournemouth (*loc. cit.*, p. 314); larvæ and pupæ were obtained between September 6th-20th at Ringwood, from which two imagines were bred on October 3rd and 14th (*loc. cit.*, p. 321). But imagines, principally ♀s and not in good condition, were taken throughout early and mid-August, followed by fine recently-emerged ones during September and October, but not in any very great numbers. It is well-known that this insect is long-lived, and that its eggs are slowly matured during the whole imaginal life, and that, as we have already stated, without food the imagines soon die, and that their eggs remain undeveloped*. There appears to be no doubt, therefore, that the early August, 1901, examples were the remnants of the probable immigrants of

* When Poulton exhibited larvæ of this species, reared from eggs laid August 29th by a ♀, taken in South Devon (see *anteà*, pp. 339 *et seq.*), at the meeting of the Ent. Soc. of London, October 5th, 1887, McLachlan is reported to have remarked that "♀s of this species, taken on former occasions when the insect had been unusually abundant, had been found upon dissection to have the ovaries aborted." We have found no evidence of this abortion although there is plenty to show that the eggs are ill-developed, and that the food + temperature obtainable in these islands in September and October are not altogether sufficient to enable the ♀s to develop them satisfactorily. (See also *anteà*, p. 338, footnote 2.)

June-July. Hyde observes *(loc. cit.*, p. 314) that the imagines were plentiful in early August at Portland, but only in fair condition, whilst fewer specimens, but in much better condition, were captured in September; the fact that he obtained a larva on August 2nd, and a pupa on September 22nd made him believe the late September-October imagines were freshly emerged; Fowler also notes *(loc. cit.*, p. 321) that imagines were common from August 16th to the end of the month, chiefly ♀s, and that they occurred up to September 13th; then there was a break, and no more were seen till the first week of October, when four perfectly fresh ♂s were netted. Several records note that imagines were found, towards the end of the season, on the ground more or less moribund. Careful comparison of the detailed "times of appearance" *(posteà*, pp. 379 *et seq.)* for the various years in which the species has occurred in the British Islands will give students further material in this direction. Mason notes (*Young Nat.*, x., p. 233) that bats attack the moths when on flight at flowers; he says that, at Clevedon, he saw them swoop down on the moths, but did not observe that they caught any although they spoiled his sport.

Time of appearance.—In the subtropical home of this species the insect is possibly almost continuously-brooded, passing, however, its hybernating period (so far as it has any) in the pupal state. Harker notes that, in Grand Bassam, the pupal period is exceedingly short, rather less than a fortnight *(Ent.*, xxix., p. 66), and that the insect goes through its metamorphoses in a very short time, and this appears to be true also in India, North Australia, and the Pacific Islands. In Madeira, northern Africa and localities with a somewhat similar limited winter, the species appears to be more or less sedentary and double- or triple-brooded, appearing in April-May, July-August and October, whilst parallel habits possibly prevail in countries with a similar climate south of the equator. It is possible that the species never passes the winter successfully in the greater part of the Palæarctic region, and certainly almost all the specimens taken in Europe and northern Asia are either immigrants or the direct descendants of immigrants from subtropical climes. Even at Hyères, although the imagines are abundant in August and early September at flowers of honeysuckle, convolvulus and petunias, the imagines have not, Powell asserts *(in litt.)*, been seen at large in June, although an imago emerged in confinement on May 27th, 1903, from a pupa which had been exposed all winter, to all weathers and temperatures, on an outdoor balcony. He adds that if this represents a first brood, it must be a very small one. Similarly in Britain, even in confinement, there are no records of an imago emerging from a pupa that has spent the winter as a pupa, except that already noted *(anteà*, p. 343, footnote). The summer and autumnal larvæ and pupæ that have been obtained in Britain *(anteà*, pp. 343-345) have either gone through their changes (naturally or by forcing) rapidly to the imaginal state, or died, and a similar condition occurs throughout all temperate regions, the warmer the district and the less marked its winter, the greater being the percentage of successful emergences, due largely to the greater ease with which the larvæ can obtain food. In some seasons, *e.g.*, 1857, 1858, 1859, 1868, and 1887, immigrant imagines appear in June

and early July, and larvæ are obtained in August, and imagines again in September and October. In other years, *e.g.*, 1895, 1901, &c., immigrant imagines appear in August, larvæ and pupæ from September to November, and imagines from October until killed off by the winter, only forced pupæ, in confinement, maturing their imagines. In other years, *e.g.*, 1860, 1861, 1871, 1875, 1876, 1877, 1881, 1883, 1885, 1886, immigrant imagines do not appear until late August and September, and, in such years, probably due to insufficient food or temperature, or both, eggs are rarely deposited or larvæ found. The mode of occurrence of the species from Britain across Europe and Asia to northern Japan is very similar, and the occasional capture of isolated early summer examples leads to the statement in most local European lists of lepidoptera that the species occurs in "May-June" and "August to October," with a saving clause frequently added, "sometimes in July." Thus, Bartel, who summarises the German records, notes (*Pal. Gross-Schmett.*, ii., p. 39): "The imagines emerge either after a pupal period of four weeks, between August and October of the same year, or more rarely from hybernated pupæ in May and June, exceptionally also in July. The moths emerging in August and September are not adapted to yield progeny, and those larvæ which, with us, are observed still in October and November, mostly fall victims to the early advent of cold, and cannot, therefore, be the offspring of the autumn brood as is often erroneously stated, but must come from winter pupæ that were specially late in developing."* Most of the records for the continent of Europe and northern Asia suggest that the appearances are identical with ours in Britain, and consist of the general statement of an early and late brood, the remarks concerning the former pointing either to its great rarity or to a theoretical acceptance of an early one in order to explain the later one. Thus, we have June and July, and again in September and October in the Netherlands (Snellen), in June and September in Belgium (Derenne), May-June and again August-October in Germany (Heinemann), May-June and often very abundantly in August-September at Baden (Reutti), June rare, and August-September at Crefeld (*teste* Bartel), June and September-October at Halle (Stange), May-June and August-September in Thuringia (Krieghoff), end of May and again in September at Wiesbaden (*teste* Bartel), June and September in Alsace (Peyerimhoff), June and again in August-September at Budapest, mid-June to the end of September in Tuscany (*teste* Bartel), June and again in September-October at Collo, in Algeria (Seriziat), all point to an occurrence very similar to that in England though details are wanting to show how rare the examples of the so-called early brood are in the northern, and how far more abundant in the more southern, European countries. But none of these eliminate the facts exhibited in our details and dates of appearance, *viz.*, that besides occasional May-June examples (which are almost certainly immigrants) there may be distinct July-August and September-October

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* This paragraph is altogether erroneous and misleading (see *anteà*, pp. 343-345 and 376) where are several definite cases of larvæ, pupæ and imagines obtained from August-September parents. The eggs on which Poulton's life-history of this species was based (*anteà*, pp. 337 *et seq.*) were laid on August 26th, 1887.

appearances, and that whilst the first-named are almost of necessity immigrants, but may be the progeny of May-June immigrants, the last-named also may consist either of immigrant or native-born individuals in different years. As a matter of fact one can only assume that under the most favourable circumstances two native-bred broods can appear in the greater part of the Palæarctic region, and that these would be in August-September and October-November, and then only in years when immigrant ♀s reached us in May-June (a most unusual occurrence). These two latter (August and October) broods occur in Roumania (Caradja), and Fritsch gives dates extending over many years, for Austro-Hungary, from May 16th to November 5th. Two broods appear to have been pretty regularly noted in Malta, and North Africa, *viz.*, May-June and September-October, with an intermediate July-August one frequently developed, but detailed observations and actual dates are much needed. Fletcher gives May 26th, 1902, for Malta, Lucas has recorded imagines in May at Algiers, Seriziat has noted examples in June at Collo, and adds the remark that the September emergence is much more abundant and continued into October. Occasionally, as we have stated, a July flight is observed in Britain, and we note that Zapater records the species as occurring in July at Ateca, and we have also in addition, July, 1896, at light, at Aix-les-Bains (Agassiz), from July 14th to September 10th, 1893, at light at Berne (Hiltbold), very common in June-July in Transcaucasia (Romanoff), in mid-July and August at Gorki (Ball), most abundant in July at Sicily (Minà-Palumbo), &c., whilst the general statement of Fritsch that imagines occur pretty continuously in Austro-Hungary from May 16th to November 5th, could be easily matched by taking the earliest and latest recorded dates in Britain over a long series of years; the fact is, much detailed observation is needed as to the dates of appearance of this species in all countries, with a careful weighing of the probabilities as to whether the recorded specimens are really immigrants or native-born. The conditions governing the appearance of the species in the same year in various parts of the Palæarctic area may be very different; in 1898 they must have been exceedingly alike, and the simultaneous abundance of the species in August and September of that year in all countries across the Euro-Asiatic continent from Britain to Japan is perhaps noteworthy. Of its time of appearance, south of the Equator, we know little; specimens in the British Museum collection were taken by Marshall at Umtali in December, 1900, and at Salisbury, in Mashonaland, in March, 1896, whilst in New Zealand, Hudson notes the imagines as being most abundant in November and December *(anted*, p. 336), and so on. So important do we consider the unravelling of the details of the natural history of this species that we have no hesitation in giving the following long list of records of the capture of this species in Britain, trusting that additions in future years will give sufficient materials for safer generalisations than those in which we can at present indulge. These are: August 28th, 1841, several August, 1859, at Hull (Young), August 12th, 1846, at Malling Deanery, near Lewes (Merrifield), September 3rd, 1847, in Arran (Thomson), September 27th, 1853, at Bridgwater (Clark), September 2nd, 1856, an imago at Peckham (Siggs), September 8th, 1856, at Mortlake (Edon), September 9th, 1856,

two imagines at Stapleton (Harding), June 21st, 1857, at Maidstone (Hastings), September 5th, 1857, at Newhaven (Reeve), September 10th-19th, 1857, at Sidmouth (Johnson), September 10th-October 9th, 1857, at Alphington (D'Orville), a ♀ October 7th, 1857, at Surbiton (Sheppard), several at Stoke Newington, on and just before October 9th, 1857 (Newman), newly emerged October 17th, 1857, at Tenterden (Beale), one bred in October, 1857, from pupa found exposed on grass at Ashford (Russell), June 11th, 1858, at Lower Clapton (Gaviller), June, 1858, at Penrith and Kendal (Gregson), 3 in August, 1858, at Newnham (Bingham), August 24th, 1858, at Lewisham (Stainton), August 28th, 1858, an imago at Kingsland (Edon), about September 1st, 1858, at Lewes (Blaker), September 4th, 1858, at Deal, September 20th-27th, 1858, at Stapleton (Harding), September 20th-27th, 1858, at Brighton (Madden), September 20th, 1858, in Victoria Park Road (Wright), September 21st, 1858, at Sharnbrook (Graham), 5 from September 22nd-29th, 1858, at Southgate (Walker), about September 22nd, 1858, at Putney (Stevens), September 22nd, 1858, at Bermondsey (Harrison), September 23rd, 1858, in Mile End (Machin), September 23rd, 1858, at Bristol (Bolt), six up to September 24th, 1858, at Exeter (*Int.*, v., p. 11), September 24th, 1858, at Farnham (Lewcock), September 25th, 1858, at Hackney (Healy), September 25th, 1858, at Neateshead (Cubitt), September 26th, 1858, at Thurning (Whall), September 26th, 1858, at Wick (Horton), September 26th, 1858, at Wateringbury (Fremlin), September 27th, 1858, at Hove (Image), September 28th, 1858, at Thorne (Roberts), two September 28th, 1858, at Henley-on-Thames (Stubbs), September 28th, 1858, at Ryde (Moon), June 8th, 1859, at Kirkstall (Oates), August and September, 1859, many at Abbey Wood (Harris), ten at Deal in August, 1859 (Harding), August 10th-30th, 1859, at Beccles (Farr), two on August 12th, 1859, at Hove (Taylor), August 12th, 1859, at Frome (Sheppard), August 12th, 1859, captured on board a vessel in the middle of the Bristol Channel (Williams), ♀ August 15th, 1859, at Twickenham (Boscher), August 19th, 25th, 1859, at Brighton (Image), an imago August 22nd, 1859, at Herne Bay (Butler), August 22nd, 1859, at Tinahely (Bristow), August 23rd, 1859, an imago at Fordingbridge (Neave), several seen in Dublin on August 24th, 1859 (Birchall), August 26th, 1859, at Gosport (Lacy), August 26th-September 5th, 1859, at Teignmouth (Galton), an imago on August 27th, 1859, at Eastover (Sanders), August 27th-September 3rd, 1859, at Ipswich (Fison), August 29th-30th, 1859, at Aldeburgh (Garrett), an imago on August 29th, 1859, at Bridge of Allan (Wingate), ten at Cheshunt, September 1st-14th, 1859 (Boyd), September 1st-21st, 1859, at Gillingham (Chaney), September 4th-October 5th, 1859, at Cambridge (Cumming), 26 specimens between September 4th-15th, 1859, in the Isle of Wight (Fereday), September 4th, 1859, at Newsome (North), September 5th, 1859, at Breadsall (Crewe), September 7th, 1859, at Camberwell (Keen), September 7th, 1859, at Northampton (Smith), several from September 8th-17th, 1859, at Chatham (Tyrer), September 8th-15th, 1859, at Southport (Davis), September 8th, 1859, at Hartlepool (Robson), September 8th, 1859, at Hammersmith (Bird), September 10th, 1859, at Hackney (Wright), September 10th, 1859, at York (Wade), September

10th, 1859, at Lee (Turner), September 11th, 1859, at Barnstaple (Mathew), ten from September 12th-19th, 1859, at Thorp Perrow (Culverwell), September 12th, 1859, at Dalkeith (Anderson), September, 17th, 1859, at Swansea (Higginson), September 18th, 1859, at Manchester (Kenderdine), September 19th, 1859, at Newark (Hadfield), August 24th and September 13th, 1860, at Brantingham, Brough (Kingston), August 31st, 1860, at Sutton-on-Derwent (Read), September 10th, 1860, at Winchester (Dart), September 15th, 1860, at Fordingbridge (Neave), bred September 15th, 1860, from a larva obtained at Deal in autumn of 1859 (Syme), September 22nd, 1860, at Yarm (Harrison), September 11th, 1861, near Halifax (*Zool.*, p. 7760), September 12th, 1861, at Brighton (Image), September 17th, 1861, near Hull (Norman), September 19th, 1861, near Newcastle-on-Tyne (Perkins), September 22nd, 1861, near Wakefield (Gibson), October 19th, 1861, at Leominster (Hutchinson), September 19th, 1864, at Alloa (Borthwick), September 6th, 1865, at Ramsgate (Curzon), September 16th, 1866, at Bury St. Edmunds (Skepper), May, 1868, at Leominster (Hutchinson), August 6th-September 23rd, 1868, at Guestling (Bloomfield), August 8th, 1868, at Birmingham (Kenrick), August 14th, 1868, at Wolsingham (Backhouse), 27 ♂ s and 29 ♀ s between August 15th-September 28th, 1868, at Alphington (D'Orville), at Kilkea Castle, on August 17th, 1868 (Douglas), August 17th, 1868, at Doncaster (Clark), August 18th, 1868, at Painswick (Watkins), August 19th, 1868, at Newport, Isle of Wight (Moberly), August 21st, 1868, at New Romney, August 27th-September 27th, 1871, at Folkestone (T. Briggs), August 22nd, 1868, at Haslemere (Barrett), August 25th and 31st, 1868, at Marlborough (Preston), August 25th, 1868, at Windsor (A. H. Jones), September 10th or 12th, 1868, near Reigate (Blackburn), October 1st, 1868, at Stirling, on October 5th, 1868, at Alloa (Borthwick), September 13th, 1869, in Greenwich Park (West), August 15th, 1870, near Chepstow (Sellon), August 16th, 1871, at Droylsden (White), September 10th, 1871, at Exeter (D'Orville), floating on the Tyne, near South Shields, September 13th, 1871 (Eales), September 14th-17th, 1871, at Wanstead (Burrows), October 3rd, 1871, at Copley, near Stalybridge (Kershaw), October 7th, 1871, at Highgate (Davis), October 30th, 1872, at Warwick (Baly), August 30th, 1873, at Longroyde Bridge (Varley), September 6th, 1873, at Oxton (Studd), September 12th, 1873, at Lewes (Mond), September 18th, 1873, at Walthamstow (Cooper), October 3rd, 1873, at Christchurch (McRae), September 9th, 1874, at Maidenhead (Harker), last week in July, 1875, at South Shields, August 24th, at Cullercoats (Wasserman), August 12th-17th, 1875, at Swanbister (Boswell), 19 between August 12th and September 7th, 1875, at Darlington, 14 others after last-named date (Law), August 26th-September 24th, 1875, at Guernsey abundant (Luff), August 30th, at Tottenham, August 31st, 1875, at Bexley (Cooper), September, 1875, 12 near Dover (Webb), September 1st, 1875, at Birkenhead (Povall), 60 from September 16th, 1875, at Hackney, none after October 1st, although weather favourable, also September 20th, at Kennington (Biggs), September 6th, 1875, at Barrow-on-Trent (Smallwood), September 7th, 1875, at Row (Pearson), September 9th-16th, 1875, at Witham (Cansdale), September 9th, 1875, at Glenarm Castle, near Larne (Brunton), September 10th,

1875, at Eastbourne (Parsons), September 13th, 1875, at Stoke Newington (Harris), September 14th, 1875, at Clifton (Mann), September 14th-15th, 1875, at Christchurch (McRae), September 15th, 1875, at Hazeleigh (Raynor), four between middle of September and beginning of October, 1875, at Honiton and Exeter (D'Urban), September 17th, 1875, at Gravesend (Jennings), September 17th, 1875, at Dublin (Pease), September 17th-21st, 1875, at Detling (Cave-Browne), September 18th, 1875, at Winchmore Hill (Browne), September 19th-25th, 1875, at Newton Abbot (Vicary), September 20th, 1875, at Lincoln (Trafford), September 20th, 1875, at Hawley (Jones), September 20th, 1875, at Norwich (Laddiman), September 20th, 1875, at Huddersfield (Madden), September 20th, 1875, at Hammersmith (Cowan), September 22nd-26th, 1875, at Newport (Morey), September 23rd, 1875, at Bowdon (Stürmer), September 24th, 1875, at Solihull (Martineau), September 24th, 26th, 1875, at Lee (Bower), September 24th, 1875, at Croydon (Frohawk), September 24th, 1875, at Worthing, September 25th, at Leeds (Smethurst), September 25th, 26th, 1875, at Sheffield (Clark), September 26th, 1875, at Hendon (South), September 30th, 1875, at Petersfield (Waldegrave), September 30th, 1875, at Malvern (Edwards), October 3rd, 1875, at Peckham (Barrett), August 22nd, 1876, at St. Ives (White), August 23rd, 1876, at Deal (Andrews), September, 1876, at Exeter (Hellins), first week in September, 1876, at Winchester (Johns), September 7th, 1876, at Wotton-under-Edge (Perkins), September 7th, 1876, at Salisbury (Neale), October 2nd, 1876, at Christchurch (McRae), October 13th, 1876, at Clifton (Mann), September 3rd, 1877, at Rothwell (Smethurst), September 3rd, 7th, 1877, at Harwich (Kerry), September 5th, 1877, at Putney (Rose), September 16th, 1877, near Ryde (Benson), September 16th, 1877, at Ipswich (Jackson), September 17th, 1877, near Walthamstow (Downing), September 20th, 1877, at Kingswood (Melson), October 2nd, 1877, at Wotton-under-Edge (Perkins), October, 1878, on the sands at Seaton Carew (Robson), September 26th, 1880, at Caversham (Holland), July 20th, 1881, in London (Cooper); August 24th, 1881, at Jedburgh (Elliot), August 25th, September 10th, 1881, at Burton-on-Trent (Thornewill), August 27th, 1881, at Hackney Downs (J. A. Clark), end of August and beginning of September, 1881, near Malvern (Law), September, 1881, at Southwell (Baker), September 2nd, 1881, at Gateshead (Bramwell), September 7th, 1881, at Leeds, September 27th, 1881, at Burnley (Smethurst), September 8th, 1881, at Tresco (Bliss), September 9th, 1881, at York (Langley), September 10th, 1881, at Ashbourne (Hall), September 10th, 1881, at Reading (Butler), September 11th, 1881, at Bockleton (Decie), September 16th, 1881, at Tottington (Slipper), September 16th, 1881, at Handsworth (Deakin), September 22nd, 24th, 30th, 1881, at Norwich (Thouless), September 23rd, 1881, in Kirkcudbright (Haltwhistle), August 28th, 1883, at Aberdeen (Mundie), August 29th, 1883, at Stoneygate (Bouskell), September 2nd, 1883, at Gunnersbury (Mitchell), September 5th, 1883, at Nottingham (Wright), September 11th, 1883, at Southend-on-Sea (J. A. Clark), September 12th, 1883, at Bournemouth (McRae), September 14th, 1883, at Chichester (Anderson), September 15th, 1883, at Hitchin (Durrant), September 19th, 1883, at Walthamstow (Jobson), September,

1883, at Carmarthen (Hearder), August, 1884, at Torquay (James), September 10th, 1884, at Mansfield (Daws), September 26th, 1884, at Parkeston, near Harwich (Kerry), August 11th, 1885, at Clavering (Nash), August 11th-31st, at Harwich (Kerry), August 14th, 1885, and following days, at Christchurch (Druitt), August 14th, 1885, and following days, at Lewes (Nicholson), August 17th-September 12th, 1885, at Lindfield (Blaber), August 20th, 1885, at Bembridge (St. John), August 21st, 1885, near Hartlepool (Robson), August 24th, 1885, at Walthamstow (Goldthwait), August 28th-September 6th, 1885, at Castle Cary (Macmillan), August 28th, 1885, at Rotherhithe (Cook), August 30th, September 6th, 1885, at Lee, near Ilfracombe (Blandford), August 31st, September 5th, 1885, at Leicester (Tristram), August, 1885, abundant in the Scilly Isles (Jenkinson), September 1st, 1885, at Broxbourne (Coste), September 1st-17th, 1885, at Kenley (Venables), September 2nd, 1885, near Emsworth (Christy), September 3rd, 1885, at Wells (Livett), September 4th, 1885, at Detling (Cave-Browne), September 5th, 1885, and following days, at Northampton (Bostock), September 5th, 1885, at Holloway (Mutch), September 5th, 1885, in Regent's Park (Beddard), September 6th, 1885, and onwards, many specimens at Ilfracombe (Copp), September 6th, 8th, 9th, 10th, 11th and 14th, 1885, at Footscray (Williams), September 6th, 1885, at Sevenoaks (Meldola), eight from September 7th-14th, 1885, at Portland (Walker), several first week in September, 1885, at Chichester (Anderson), September 8th, 1885, at Wannock (Pearson), September 8th, 1885, at Beckenham (Bailey), September 11th, 1885, at Firle (Edgell), September 12th, 1885, at Llanfairfechan (Jenkinson), September 13th, 1885, at Bury (Kay), August 7th, 1886, at Holloway (Field), ♀ and ♂ on different days in the first week in September, at Newbury (Hopson), September 6th, 1886, near Pitcaple (Reid), September 10th, 1886, at Reading (Holland), September 18th, 1886, at Downham (Burrows), September 18th, 1886, at Brandon (Raynor), September 28th, 1886, at Blackheath (Shute), rare October 4th, 1886, at Christchurch (Druitt), October 4th, 1886, at Loughborough (Tristram), October 7th, 1886, at light at Corfe Castle (Bankes), October 15th, 1886, at Bramley (Grover), July 7th, 1887, at Liberton Brae, near Edinburgh (Evans), August 8th, 1887, at Ilford (Tonge), August 9th, 1887, at Lowestoft (James), August 18th, 1887, at Maldon (Bentall), August 18th, 1887, at Lee (Fenn), August 19th, 1887, at Cambridge (Waters), August 20th, 1887, at Guildford (Grover), about 55 from the second week in August-September 21st, 1887, at Firle (Edgell), August 20th, 1887, at Chalfont Park (St. John), August 22nd-September 9th, 1887, abundant at King's Lynn (Barrett), August 22nd, 1887, at Windsor (Edmunds), August 22nd-29th, 1887, at Alford (Garfit), August 23rd, 1887, at Tuxford (Gain), August 26th, 1887, at Thurmaston (Barrow), August 27th, 29th, September 4th, 5th, 7th, 1887, at York (Dutton), 14 between August 27th and September 9th, 1887, at Worcester (Edmunds), August 27th, September 12th, 1887, at Christchurch (Adye), August 28th-September 8th, then a break till September 30th, 1887, at Barnsley (Rose), August 28th, 1887, at Groombridge, September 12th, 1887, at Lindfield (Blaber), August 28th, September 7th, 1887, at West Ham (Biggs), August 30th, 1887, at Aylestone, September 2nd, 1887, at Leicester

(Bouskell), August 30th, 1887, at Alum Bay, Isle of Wight (Grant), August 31st, 1887, at Haslemere (Newman), August 31st, 1887, at Putney (Lea), August 31st, 1887, near Bolton, September 4th, 1887, at Horwich (Stott), August, 1887, at Lewes (Nicholson), three first week in September, 1887, at Keymer (Bayley), September 1st, 1887, at Birmingham (Bath), September 2nd, 1887, at Bury (Hall), September 2nd, 1887, at Lowestoft (Stoneman), September 3rd, 6th, 7th, 1887, at Petersfield (Waldegrave), September 3rd-7th, 1887, at Coolinge (Cheesman), September 3rd, 1887, and following days at Cambridge (Farren), September 4th, 10th and 11th, 1887, at Portland (Flemyng), September 5th, 1887, at Coventry (Burrows), September 6th, 1887, at Hayton (Routledge), September 6th, 1887, in Battersea Park (Sutton), September 7th, 1887, at Hounslow (Powley), September 8th, 1887, at Sidcup (Williams), September 12th, 1887, at Sutton (Lee), September 19th, 1887, at Caverton (Elliot), September 21st, 1887, at Armagh (Johnson), September 28th, 1887, at Helston (Vivian), September 31st, 1887, at Carlisle (Eales), August 15th, 1888, at Epping (Bell), August 28th-30th, 1888, at York (Walker), September 1st, 1888, at Stone (Wright), September 2nd, 1888, at Polegate (Abercromby), September 12th, 1888, at Lymington (Heseltine), August 13th, 1889, at Leicester (Headly), August 20th, 1889, and following days at Clevedon (Mason), August 22nd, 31st, 1889, at Ramsgate (Willson), August 22nd, 1889, at Brentwood (Raynor), August 23rd, 1889, one captured at Douglas Head (Clarke), August 23rd and September 13th, 1888, at Brentwood (Burrows), August 24th, 25th, 26th, 1889, at Didsbury (Mason), August 24th, 29th, September 8th-13th, 1889, at Grange-over-Sands (Podmore), August 26th, 1889, at Oxford (Bliss), August 31st, 1889, near Reading (Tarbat), and at Reading (Holland), September, 1889, in Regent's Park (Tuck), September, 1889, at Brighton (Meaden), common in September, 1889, at Glandore (Donovan), 2 at West Lulworth 1st week in September, 1889 (Barrett), September 10th, 1889, at Lincoln (Musham), September 10th, 1889, at Christchurch (Adye), September 11th-12th, 1889, at Freshwater (Hodges), September 11th, 1889, at Penrith (Birkenhead), August 23rd, 1890, at Hartlepool (Robson), August 17th, 1891, at Keston, September 27th, 1891, near Farnborough (Alderson), 13 between August 20th-September 20th, 1891, at Sketty Park (Robertson), August 22nd, 1891 at Grange-over-Sands (Booth), August 25th, 1891, at Douglas (Clarke), August 26th, October 8th, 1891, at Chichester (Anderson), August 26th, 1891, on Douglas Pier, October 26th, 1891, at Onchan (Clarke), 15 between August 28th and September 30th, 1891, at Clevedon (Mason), August 29th, 1891, at Freshwater (Hodges), September 2nd, 1891, at Lincroft (Hewett), September 7th, 1891, at Dumfries (Service), September 7th, 1891, at Ramsgate (Willson), September 8th, 1891, at Winchester (Hewett), September 12th, 1891, at Pitcaple (Reid), September 25th, 1891, at Ripon (Chapman), September 30th, 1891, at Burton-on-Trent (Thornewill), October 7th, 1891, at Peebles (Evans), October 13th, 1891, at Reading (Holland), October 19th, 1891, at Hartlepool (Robson), June 6th, and September 14th, 1892, at Newbury (Beales), 18 from August 20th, 22nd, 31st to September 18th, 1892, at Sketty Park (Robertson), August 20th, worn, September 27th-30th, 1892, quite

fresh at Winchester (Hewett), August 20th, 1892, at Panton (Raynor), August 26th, 1892, at Seabrook (Chittenden), September, 1892, at Emsworth (Christy), September 6th, 1892, at Brockenhurst (Adye), September 6th, 1892, at Harrow (Rhoades-Smith), September 7th-9th, 19th, 20th, 22nd, 1892, at Freshwater (Hodges), September 17th, 24th, 1892, at Brockenhurst (Meek), September 20th, 1892, at Reading (Holland), September 21st, 1892, at Exmouth (Cripps), September 21st, 1892, at Bexley Heath (Andrews), September, 1894, at Ayr (Fergusson), September 29th, 1894, in south Devon (Chope), 16 between August 11th-October 2nd, 1895, at Christchurch (Druitt), August 12th-October 7th, 1895, 51 specimens at Portland (Hyde), August 20th-September 25th, 1895, at Honiton (Riding), August 24th, 1895, at Ilminster (Hayward), August 25th, 1895, at Rainham (Burrows), August 27th, 1895, at Rusthall Common, near Tunbridge Wells (Dallas-Beeching), August 28th and 29th, 1895, and then no more till from September 20th-30th, at Clevedon (Mason), August 31st, September 9th, 1895, at Strichen (Salter), two dozen captured during the last week in August and first week of September, 1895, on the Holderness coast (Hewitson), 7 first week in September, 1895, 11 more during the next week (*teste* Frohawk), September 1st-8th, 1895, at Waldringfield (James), September 2nd, October 7th, 1895, at Portscatho (Step), September 3rd, 1895, at Dovercourt (Mathew), September 3rd, 1895, at Castle Cary (Macmillan), September 5th, 7th, 1895, two at Sidmouth (Neel), September 7th, 1895, at Braunton Burrows (Bartlett), September 7th, 8th, 1895, at Oxton (Studd), September 7th, 1895, at Carlisle (F. H. Day), 23 up to September 10th, 1895, at Winton (Hooker), September 12th, 1895, at Epsom (Morley), September 18th, 1895, at Market Rasen (Lewington), September 21st, 1895, at Douglas (Mackonochie), September 26th, 1895, at Watford (Spencer), two last week in September, at Chichester (Anderson), October 18th, 1895, at Lochiar (Kearney), July 3rd, 1896, at Colchester (Harwood), July 29th, 1896, at Gloucester (Rea), August 31st, 1896, at Honiton (Riding), 16 between September 12th-15th, 1896, at Oxton (Studd), September 16th, 1896, at Reading (Butler), September 17th, 1896, at Sandown (Prout), September 21st to end of October, 1896, in Isle of Man (Clarke), 11 between August 14th and September 16th, 1897, at Portland (Hyde), August 16th-September 3rd, 1897, in the Scilly Isles (Adkin), August 19th, 1897, at Market Rasen (Lewington), August 19th, 1897, at Sudbury (Ransom), August 27th, 1897, at Carlisle (F. H. Day), August 31st, 1897, one at Maryport (Wilkinson), August 31st, 1897, at Salisbury (Gummer), last week in August, 1897, at Market Drayton (Woodforde), September 3rd, 1897, at Chichester (Anderson), September 3rd, 1897, at Sutherland (Christy), September 3rd, 1897, at Worksop (Alderson), September 3rd, 7th, 1897, at Malvern (Edwards), September 3rd, 14th, 1897, at Waldringfield (James), September 4th, 1897, at Bentley (Burrows), September 6th, 1897, at Barnsley (Harrison), September 6th, 1897, at Windermere (Crewdson), September 9th, 1897, at Lee (Bower), September 14th, 1897, in Piccadilly (Bell-Marley), September 15th, 1897, at Wishaw (Harkness), September, 1897, at Kilbarchan (Dalglish), 52 between August 4th-October 3rd, 1898, at Portland (Hyde), August 13th, September

10th, 1898, at Dawlish (Rogers), August 24th-September 8th, 1898, in the Scilly Islands, September 13th, 1898, at Bromley (Adkin), last week in August, 1898, at Market Drayton (Woodforde), August 28th, September 17th, 18th, 19th, 21st, 1898, all at Waldringfield (James), August 29th to end of September, 1898, at Honiton (Riding), September 3rd, 4th, 1898, at Sidmouth (Wells), September 4th-14th, 1898, at Douglas (Clarke), September 10th-20th, 1898, at East Grinstead (Burr), September 14th and 17th, 1898, at Weybridge (Tarbat), September 14th, 1898, abundant at Guernsey (Hodges), September 16th-20th, 1898, at Paul (Daws), September 16th-24th, 1898, common at Oxton (Studd), September 16th, 1898, thirteen at Weymouth (Peachell), September 17th, 20th, 1898, at Reading (Butler), from September 17th-24th, 1898, at Willesborough (Chittenden), September 17th-22nd, 1898, in Guernsey (Lowe), September 17th, 1898, at Chislehurst (Thornthwaite), September 18th, 1898, at Dorking, September 20th, at Great Tower Street, London (King), September 19th-22nd, 1898, at Boxworth (Thornhill), September 19th-24th, 1898, at Canterbury (Small), September 20th-24th, 1898, at Stonehouse (Nash), September 20th, 1898, at Seaford (Hill), September 20th, 1898, at Mansfield (Daws), September 20th-25th, 1898, at Bridgwater (Cottam), September 20th-30th, 1898, at Ryde (Bevis), about September 20th, 1898, at Mallow (Bingham-Newland), September 21st, 1898, at Ewell (Ficklin), September 21st, 1898, at Nunhead (Russell), September 22nd, 1898, at Brockenhurst (J. A. Clark), about September 22nd, 1898, at Stratford (Mera), September 24th, 1898, at Lynmouth (Cotton), September 29th, 1898, at Addlestone (Taylor), October 3rd, 1898, at Tunbridge Wells (Dallas-Beeching), October 4th, 1898, at Moseley (Imms), about November 4th, 1898, at Dover (Stockwell), 20 between August 25th and September 20th, 1899, at Portland (Hyde), August 26th, 1899, at Oxton (Studd), August 27th, 1899, and following days in Guernsey (Lowe), first week of September and until the 23rd, 1899, at Honiton (Riding), September 1st, 1899, at Penarth (Howe), September 1st, 1899, at Boscombe (Robertson), September 3rd-6th, 1899, at Dawlish (Rogers), September 6th, 1899, near Bowness (Moss), September 11th, 1899, at Bridgwater (Cottam), September 16th-26th, 1899, fairly abundant at Penzance (Daws), September 20th, 1899, at Ramsey, September 26th, 1899, at Maughold (Clarke), September, 1899, at Sudbury (Ransom), last week in September, 1899, at Manningham (Carter), one in October, 1899, at Esher (Fleet), October 1st, 1899, at Deal (Stockwell), October 8th, 1899, at Burnley (Clutten), August 13th, 1900, at Wandsworth (Miller), August 20th, 1900, at Portpatrick (Service), August 28th-September 4th, 1900, at Mansfield (Daws), one on September 2nd, 1900, at Maldon (Raynor), September 7th-October 9th, 1900, at Portland (Hyde), September 27th, 1900, at Alderley Edge (Oldham), September, 1900, at Dorking (Oldaker), September 30th, 1900, near Douglas (Clarke), ♂ imago, June 2nd, 1901, imagines common throughout August, fewer but in better condition in September, 1901, at Portland (Hyde), worn imagines on June 30th ♀, July 2nd ♀, July 10th ♀, and July 11th, 1901, ♂, at Elstow (Pestell). July 5th, 1901, at Bremhill (Eddrup), July 16th, 1901, at Doncaster (Eden), July 16th, 1901, at Wandsworth (Miller), July 24th, 1901, at Boston

(Disbrowe), two imagines 1st week in August, 1901, at Tavistock, another September 7th at Grenofen (Phillips), one worn on August 12th, 1901, then none till September 8th, on which and following days many were caught at Chichester (Anderson), August 12th, 1901, at Maynard's Green (Delves), August 13th-15th, 1901, at Hythe, near Southampton (Kemp), August 13th, 1901, at Elgin (Brown), August 15th, and then during the first week in October, 1901, at Woodbridge (Waller), imagines August 16th, 1901, at Eartham (Giles), swarmed in North Suffolk from August 17th, 1901, on into September (Green), abundant from August 17th, 1901, later in September, and up to October 9th in better condition, in Guernsey (Lowe), August 17th, 1901, at Leeds (Roebuck), imagines August 18th-19th, 1901, at Maldon (Fitch), August 18th, 1901, at Bexhill (Evans *teste* Sich), August 18th-23rd, 1901, specimens worn, on September 8th and 9th, 1901, several quite fresh, at Kelvedon (Reid), 15 from August 18th-October 10th, 1901, at Clevedon (Lawson), imagines between August 19th-September 10th, 1901, at Dovercourt (Mathew), imago August 20th, 1901, at Fakenham (Woolhouse), two imagines August 20th, 1901, two on the 25th, one on the 26th, one on the 28th, and several seen later, at Yelverton, at 800ft. elevation (Nash), August 23rd, 1901, at York (Walker), August 24th, 1901, between Chessington and Bones Gate, September 21st, at Kingston-on-Thames (Goss), imagines August 25th, 1901, at Caterham Valley (Seth-Smith), imagines August 29th and September 12th, 1901, at Bakewell (Boulsover), imago August 30th, 1901, at Bromley (Hill), 203 in August and September, 1901, at Bournemouth (Hooker), 1 specimen captured near Harlech in late August 1901 (*teste* Graves), September 1st, 1901, at Highgate (Spencer), September 2nd, 1901, at East Dulwich (Colthrup), September 3rd, 1901, at Bridport, September 4th, 1901, at Chilwell (Pearson), September 4th-9th, 1901, at Margate (Barrett), September 5th, 1901, at Chathill [Recorded as *S. ligustri* (*Nat.*, 1901, p. 291)] (Allhusen), September 6th, 26th, 1901, at Hampstead (Hopson), September 7th, 1901, at Grenofen (Chichester), 5 on September 9th, 30 September 10th, 1901, at Hayling Island (May), September 10th, 1901, near Totland Bay, about 180 imagines at Bournemouth from September 10th-October, 1901 (Crallan), September 11th, 1901, at Hammersmith (Dollman), imagines September 11th-27th, 1901, at Sudbury (Ransom), September 14th, 18th, 1901, at Blackrock (Greer), September 14th, 1901, at Lydd (Brown), abundant September 14th and 15th, 1901, at Burgess Hill (Dollman), September 20th, 1901, at St. John's College Park (Kitchener), September 21st, 1901, at Ilford (Adams), September 21st, 22nd, 23rd, 27th, October 2nd, 1901, at Truro (Rollason), September 22nd, 25th, October 5th, 1901, at Esher (Fleet), September 22nd, 1901, at Willesborough, others September 24th and 25th at Lewisham (Chittenden), September 22nd, 1901, one at Lee (Carr), September 23rd-October 1st, 1901, at Boxworth (Thornhill), September 23rd, 1901, at Aldeburgh (Walker), September 23rd, 1901, at Pewsey (Sladen), September 23rd, 1901, at Wotton-under-Edge (Toulmin), 10 imagines between September 24th-25th, 1901, at Forest Gate (Harrison), 14 taken and others seen on September 24th, 25th, 26th, 27th, 1901, at Minehead (Cotton), September 25th, 1901, at Bushey Heath (Barraud), September 25th, 1901, at Isleworth

(Walch), September 25th, 1901, in London Fields (Alderman), several on September 26th-27th, 1901, at Eltham (Jones), September 27th, 1901, at Wellington College (Thornewill), September 27th, 28th, 30th, October 1st, 2nd, 3rd, 4th, 5th, 7th, 1901, after October 7th it became wet and cold and they ceased, the females were more abundant than the males, at Tewkesbury (Fox), 33 imagines between September 27th-October 9th, 1901, at King's Lynn (Atmore), September 28th, 1901, at Hampton-in-Arden (Wynn), September 29th, 1901, ♀ found at Holme Head (Thwaytes), September 30th, 1901, at Hoylake (Burgess-Sopp), last week of September, 1901, at Aberdovey (G. O. Day), October 1st, 1901, at Botley (Jenkyns), October 1st, 1901, at Folkestone (Hills), October 2nd, 1901, at Hadley (Grosvenor), October 3rd, 1901, at Woking (Saunders), October 3rd, 4th, 1901, at Chelmsford (Miller), many up to October 5th, 1901, at Easington (Loten), October 11th, 1901, at York (Hewett), one bred October 13th, 1901, from larva found at Chilwell, August 26th, 1901, and that buried August 29th, 1901 (Pearson), August 15th, 1902, at Easington [This specimen after being liberated was caught by a sparrow (*Nat.*, 1902, p. 368)] (Loten), August 26th, 1902, a specimen captured at Esher (Fleet), ♀ specimen caught September 3rd, 1902, near Wick (Rosie).

LOCALITIES.—ABERDEEN: uncertain, sometimes not rare, Pitcaple, &c. (Reid), Strichen (Salter), Aberdeen (Mundie), Rubislaw (Buchan), Fyvie (Macintosh). ANTRIM: Glenarm Castle, near Larne (Brunton). ARMAGH: Armagh (Johnson). AYRSHIRE: Kilmarnock (Dalglish), Ayr (Fergusson). BEDFORD: Sharnbrook (Graham), Elstow (Pestell). BERKS: Newbury (Hopson), Reading (Butler), Maidenhead (Harper), Wellington College (Thornewill), Windsor (Edmunds), Beaumont (Gardner). BUCKS: Chalfont Park, Chalfont St. Peter (St. John), Aylesbury (Greene). BUTE: Arran—Lamlash (Thomson). CAITHNESS: Pulteney Town (Horne), near Wick (Rosie). CAMBRIDGE: Cambridge (Cumming), Chatteris (Fryer), Ely (Fisher), Haddenham (Barton), Newmarket (Verrall), Boxworth (Thornhill), Whittlesea (Stevens). CARMARTHEN: Carmarthen (Hearder), Langharne (Jefferys). CARNARVON: Llanfairfechan (Jenkinson). CHESHIRE: occasionally (Ellis), between Birkenhead and Hoylake (Povall), Eastham Wood (Johnson), Eaton Park, Denhall (Walker), Liscard (Cooke), New Brighton, Oxton (Gregson), Wallasey (Ellis), Macclesfield (Goodall), Bowdon (Stürmer), Congleton (Tagg), Netherleigh, Chester (Thompson), Ince (Newstead), Little Budworth (Stock), Vicar's Cross (Pitcairn-Campbell), Tarvin Sands (Frewin), Alderley Edge (Oldham). CLACKMANNAN: Alloa (Borthwick). CORK: Mallow, Longueville (Bingham-Newland), Lochiar (Kearney), Glandore, Timoleague (Donovan). CORNWALL: Paul, near Penzance (Daws), Land's End (Noye), Penzance (Hayward), Scilly Isles—Tresco (Adkin), Liskeard (Moon *teste* Griffiths), Truro (Rollason), Portscatho (Step), Port Wrinkle, near Whitsand Bay (Sturt), Helston (Vivian), St. Austell (Hodge). CROMARTY: Cromarty (Stainton), Dingwall (Davidson). CUMBERLAND: Keswick (Beadle), Carlisle (Armstrong), Hayton (Routledge), Holme Head (Thwaytes), Penrith (Gregson), Maryport (F. H. Day). DENBIGHSHIRE: near Chirk (Alderson). DERBY: sometimes common in the south of the county (Payne), Burton district, occasionally (Brown), Repton (Garneys), Barrow (Smallwood), Dore (Clark), Burton-on-Trent (Mason), Breadsall (Crewe), Ashbourne (Hall), Bakewell (Boulsover), Derby district (Pullen), Mickleover (Bindley). DEVON: Newton Abbot (Holdaway), Dawlish (Rogers), Tavistock (Phillips), Plymouth (Basden-Smith), Teignmouth (Galton), Honiton (Riding), Sidmouth (Johnson), Torquay (James), Exeter (Hellins), Alphington (D'Orville), Oxton (Studd), Bideford, Barnstaple (Mathew), Morthoe (Longstaff), Devonport (Hayward), Wonford (Rowland-Brown), Lynmouth (Cotton), Topsham (Kane), Braunton Burrows (Bartlett), Exmouth (Cripps), Horrabridge (Still), Ilfracombe, Buckfastleigh (Blandford), Starcross (Powley), Salcombe (Sutton), Yelverton (Nash), Bagtor, on the borders of Dartmoor (Vicary). DORSET: Weymouth (Peachell), Portland, common in 1883 (Walker), The Grove, Portland, 1895 (Hyde), Studland, Corfe Castle, West Lulworth (Bankes), Bridport (J. P. Barrett), Bloxworth (Cambridge), Sherborne (Douglas). DUBLIN: Dublin

(Birchall), Blackrock (Greer), Howth (Hart), Kingstown (Kane). DUMBARTON: Row, near Heleusburgh (Pearson). DUMFRIES: Dumfries (Service). DURHAM: occurs spasmodically—Hartlepool (Robson), South Shields (Wasserman), Darlington (Law), Wolsingham (Backhouse), Stockton (Sibson), Gateshead, Swalwell (Bramwell), Sunderland (Brady), Axwell (Nowell). EDINBURGH: Dalkeith (Anderson), Liberton Brae (Evans). ELGIN: Elgin (Brown). ESSEX: Wanstead, Brentwood, Mucking, Rainham (Burrows), Hazeleigh (Raynor), Walthamstow (Goldthwait), Stamford Rivers (Taylor), Southend, Shoeburyness, Hadleigh (Whittle), Stratford, Ilford, (Murray), Chelmsford (Miller), Forest Gate (Harrison), Chingford (Cooper), Maldon (Bentall), Colchester (Harwood), Witham (Cansdale), Clavering (Nash), Epping (Bell), Dovercourt (Mathew), Parkestone, Harwich (Kerry), Kelvedon (Reid). FLINT: Bagillt (Walker), Rhyl (Perkins). FORFAR: Montrose (Gunning). GALWAY: Connemara (Birchall). GLAMORGAN: Swansea (Higginson), Porthkerry (Allen), Sketty Park (Robertson), Penarth (Howe), Raymond Burr (Lovell-Keays). GLOUCESTER: Bristol district—generally distributed (Hudd), Stapleton (Harding), Bristol (Bolt), Redland, Fishponds (Griffiths), Cheltenham (Trye), Painswick, Stroud (Watkins), Newnham (Carefield), Wotton-under-Edge (Perkins), Gloucester (Rea), Clifton (Mann), Uley, Dursley (Fitzgerald), Stonehouse (Nash). Tewkesbury district (Fox). HADDINGTON: Biel, Tynninghame, Dunbar (Evans). HANTS: Winchfield (Burrows), East Liss (Marindin), Brockenhurst (Adye), Winchester (Fisher), Portswood (Meldola), Petersfield (Waldegrave), Fordingbridge (Neave), Gosport (Lacy), Bournemouth (Hooker), Boscombe (Robertson), Southampton (Moberly), Hayling Island (May), Christchurch (Mc Rae), Isle of Wight—Freshwater (Rogers), Ryde (Moon), Ventnor (Fereday), Chale (Irving), Sandown (Prout). Alum Bay (Grant), Bembridge (Fox), Newport (Moberly), Totland Bay (Crallan), Milford-on-Sea (Bridger), Winton (Hooker), Ringwood (Fowler), Emsworth (Christy). Hambledon (Aston), Hythe, near Southampton (Kemp), Botley (Jenkyns), Lymington (Heseltine), Portsmouth (Pearce), New Forest (Mitchell), Hawley, near Farnborough (Jones). HEREFORD: Hereford (Pilley), Leominster (Hutchinson), Tarrington (Wood). HERTS: Cheshunt (Boyd), Bushey Heath (Barraud), Hitchin, Baldock (Durrant), Watford (Cottam), Broxbourne (Coste). HUNTINGDON: St. Ives (White). ISLE OF MAN: Douglas, Ramsey, Onchan, Maughold, Maughan, Seafield, Santon (Clarke). KENT: uncertain in Rochester and Chatham district, Gillingham (Chaney), Sevenoaks (Meldola), Birchington (Golding-Bird), Faversham (Stephens), Sheerness (Walker), Folkestone (Ullyett), Beckenham (Bailey), Cooling (Cheeesman), Sidcup, Footscray (Williams), Chislehurst (Thornthwaite), Dover (Stockwell), Dulwich, Sydenham (Sellon), Farnborough, Keston (Alderson), Greenwich Park (West), Cranbrook (Burrows), New Romney, Canterbury (T. Briggs), Chatham (Tyrer), Cobham, Gravesend (Ridley), Wye (Theobald), Sidcup (Hickling), Tenterden (Beale), Maidstone (Hastings), Herne Bay (Butler), Bromley (Adkin), Wateringbury (Fremlin), Deal (Harding), Blackheath (Shute), Abbey Wood (Harris), Lee (Turner), Ashford (Russell), Detling (Cave-Brown), Bexley (Cooper), Rusthall Common, Tunbridge Wells (Dallas-Beeching), Bexley Heath (Andrews), Seabrook, Willesborough, Lewisham (Chittenden), Hythe (Greenwood), Ramsgate (Willson), Margate (Barrett), Rotherhithe (Cook), Eltham (A. H. Jones), Darenth Wood (Harding), Deptford (Newman), Lydd (Brown), Sunbury (Williams). KILDARE: Kilkea Castle, Kildare (Douglas). KIRKCUDBRIGHT: Kirkcudbright (Haltwhistle), Dalbeattie (Armistead), Kirklebride (Service). LANARK: Douglas (Mackonochie), Glasgow (King), Wishaw (Harkness). LANCASHIRE: occasionally (Ellis), Broad Green, Huyton Park, Liverpool (Capper), Bury (Kay), Copley, near Stalybridge (Kershaw), Droylsden (White), Fleetwood (Moseley), Hale (Gregson), Preston (Hodgkinson), Manchester (Kenderdine), Middleton (Thorpe), Stalybridge, Stretford, Barton Moss (Chappell), Southport (Tyrer), Burnley (Clutten), Lancaster (Taylor), Carnforth (Murray), Grange-over-Sands (Booth), near Bolton, Horwich (Stott), Liverpool (Pierce), Bowness (Moss), Didsbury (Mason). LEICESTER: near Leicester (Plant), Leicester (Headley), Loughborough (Tristram), Stoneygate, Sparkenhoe Street, &c. (Bouskell), Thurmaston (Barrow), Aylestone, New Walk, &c. (Rowley), Gumley (Matthews). LINCOLN: Brandon, Panton (Raynor), Great Grimsby (Dawson), Lincoln (Musham), Alford (Garfit), Market Rasen (Lewington), Grantham (Treadgold). LINLITHGOW: Boghead by Bathgate (Weir). MAYO: Enniscoe, Crossmolina (Kane). MERIONETH: Barmouth (Kerr), Aberdovey (G. O. Day), near Harlech (*teste* Graves). MIDDLESEX: Twickenham (Burrows), Tottenham (Cooper), Highgate (Davis), Upper Clapton (Brooke), Lower Clapton (Wakefield), London Fields (Alderman), Hampstead (Hopson), Hackney (Avis), Edmonton (Downing), Stoke Newington (Newman), Mile End (Machin), Southgate (Walker), Sunbury (Williams), Kilburn (Wormald), Holloway (Mutch), Hammersmith (Bird),

Lower Clapton (Gaviller), Winchmore Hill (Browne), Kingsland (Edon), Gunnersbury (Mitchell), Hendon, Mill Hill (South), Harrow district — Harrow (Hanbury-Barclay), near Woodlands (Melvill), Grove Hill (Rhoades-Smith), Kingsbury (Bond), Crouch End (James), Hadley (Grosvenor), Isleworth (Walch), St. John's Wood (Godwin), Bedford Park (Nash), Mark Lane Station (King), Shoreditch (Harding), Regent's Park (Beddard), Acton (Woodhams), Hounslow (Powley). MONMOUTH: Chepstow (Sellon). NORFOLK: Neateshead (Cubitt), Norwich (Moss), Harleston (Muskett), Whitwell (Freeman), Cromer (Barclay), Aylsham (Frere), near Yarmouth, Caistor Marrams, a flight (Fitt). King's Lynn (Atmore), Tottington (Slipper), Fakenham (Woolhouse), Cromer (Johnson). NORTHAMPTON: Thurning, near Oundle (Whall), Northampton (Smith), Barnwell (Waters). NORTHUMBERLAND: abundant along the coast in 1875 (Maling), occurs spasmodically, near Seaton Sluice, Seaton Carew (Robson), Chathill (Allhusen), Cullercoats (Wasserman), Newcastle (Backhouse), Mitford Hall (Finlay), Alnwick (*teste* Frohawk). NOTTINGHAM: Tuxford (Gain), Mansfield (Daws), Nottingham (Smith), Edwinstowe (Clark), Newark (Hadfield), Chilwell (Pearson), Worksop (Alderson), Wellingborough (Bates), Southwell (Baker). ORKNEY AND SHETLAND: Swanbister (Boswell), Stromness (Cheesman), Unst (McArthur). OXFORD: Chipping Norton (Goatley), Caversham (Holland), Henley-on-Thames (Stubbs). PEEBLES: Peebles (Evans). PEMBROKE: Pembroke (Barrett), Tenby (Meynell). PERTH: not common, Forth, Earn, Gowrie, Perth and Rannoch districts, Craigie. Elcho, Moncrieffe, Scone (F. B. White). RENFREW: Kilbarchan (Stewart), near Paisley (Smith). ROSSHIRE (White). ROXBURGH: Hawick district, frequent (Guthrie), Galashiels (Haggart), Caverton district (Elliot). RUTLAND: Uppingham (Bell). SHROPSHIRE: Hadley (Grover). SLIGO: Lissadell (Gore-Booth), Knocknarea, Culleenamore (Russ). SOMERSET: generally distributed (Griffiths), Bristol coalfield district, generally distributed (Hudd), Ilminster (Hayward), Yeovil (Parmiter), Clevedon (Bartlett), Castle Cary (Macmillan), Brislington (Sircom), Eastover, Bridgwater (Sanders), Taunton (Rawlinson), Frome (Sheppard), Wellington, Milton, near Brean (Vaughan), Wells (Livett), Bramblecroft, near Bridgwater (Cottam), Minehead (Cotton). STAFFORD: north Staffordshire now and again, Madeley, Newcastle (Daltry), Market Drayton (Woodforde), Bewdley (Tyrer), Stone (Masefield). STIRLING: Bridge of Allan (Wingate), Stirling (Borthwick). SUFFOLK: periodical, sometimes common (Bloomfield), north Suffolk (Green), Downham, Bentley (Burrows), Brandon (Raynor), Sproughton, Sudbury, very rare (Ransom), Ipswich (Jackson), Beccles (Farr), Lowestoft, Waldringfield (James), Aldeburgh (Garrett), Belstead, Henley, near Ipswich, Westerfield, Stretton (Pyett), Bury St. Edmunds (Kidner), Woodbridge (Waller). SURREY: Kingston-on-Thames, Chessington and Bones Gate (Goss), Sutton (Lee), Mortlake (Edon), Croydon (Harrison), Surbiton (Sheppard), Farnham (Lewcock), Putney (Stevens), Esher (Fleet), Twickenham (Boscher), Camberwell (Keen), Carshalton, Streatham (Henderson), Dorking (Oldaker), Haslemere (Barrett), Reigate (Blackburn), Kenley (Venables), Godalming (Meldola), Windsor (Jones), Epsom (Morley), Weybridge (Tarbat), Peckham (Siggs), Bermondsey (Harrison), Nunhead (Russell), Kingston-on-Thames (Shepherd), Addlestone (Taylor), Caterham Valley (Seth-Smith), Woking (Saunders), Battersea Park (Sutton), Bramley, Guildford (Grover), Wandsworth (Miller), Putney (Lea). East Dulwich (Colthrup), Ewell (Ficklin). SUSSEX: not uncommon, recorded generally from East Sussex (Jenner), Bognor (Lloyd), Arundel (Stevens), Pashley, Ticehurst (Stainton), Worthing, Bersted, sometimes common (Fletcher), Hove, Preston, Brighton (Image), near Emsworth (Christy), Hastings district, pretty common, Guestling (Bloomfield), Hurstpierpoint (Meldola), Lindfield (Blaber), Firle, Lewes (Edgell), East Grinstead (Burr), Ore Valley, near Hastings (Sotheby), Bexhill (Evans *teste* Sich), Newhaven (Reeve), Wannock (Pearson), Eastbourne (Adkin), Rye (Henderson), Westhampnel. East Lavant (Woodbridge), Malling Deanery (Merrifield), Chichester (Anderson), Littlehampton (Fry), Maynard's Green (Delves). Newick (Mackinnon), on Sussex coast (Frohawk), Eartham (Giles), Battle (Ellman), Polegate (Abercromby). Groombridge (Blaker), Burgess Hill, Angmering (Dollman), Seaford (Hill), Keymer (Bayley). SUTHERLAND (Christy). TIPPERARY: Clonmel (Davis). TYRONE: Tyrone, Caledon (Kane). WARWICK: Solihull (Martineau), Coventry (Burrows), Kingswood (Melson), Edgbaston (Kenrick), Warwick (Baly). Birmingham (Raine), Moseley, Starborne (Imms). Hampton-in-Arden (Wynn), Handsworth (Deakin), Rugby (Edmonds). WATERFORD: Dunmore (Taylor), Waterford (Kane), Portlaw (Flemyng). WESTMORLAND: occasionally near Bowness (Moss), Windermere (Crewdson), Witherslack (Murray), Kendal (Gregson). WICKLOW: Tinahely, Wicklow (Bristow). WIGTOWN: Corsemalzie

(Gordon), Portpatrick (Service). WILTS: Bremhill (Eddrup), Salisbury (Neale Marlborough (Preston), Little Darnford (Ratcliffe), Pewsey (Sladen). WORCESTER Wick (Horton), Tibberton (Weaver), Worcester, Malvern (Edwards), Malvern Wells district (Mason), Great Malvern (Law), Holt, Ombersley (Rea), Bockleton (Decie). YORKS: about equally distributed, but apparently a rather commoner species than *Sphinx ligustri* (Porritt)—Barnsley (Harrison), Thorp Perrow, Bedale (Culverwell), Heaton, near Bradford (Carter), Brantingham, near Brough in 1860 (Kingston), Bridlington (Lawson), Doncaster (Heppenstall), Driffield (Morris), Halifax (Ogden), Harrogate (Denny), Hessle-upon-Humber (Burton), Huddersfield, several (Porritt), Hull district, occasionally (Boult), Leeds (Birchall), Leyburn (Sang), Masham, Manningham (Carter), Pontefract (Hartley), Redcar (Rudd), Richmond (Harris), Wortley, Leeds, Rothwell, Burley (Smethurst), Scarborough (Wilkinson), Selby, sometimes abundant (Hebson), Sheffield (Doncaster), Spurn, sometimes very plentiful (Lawton), Wakefield (Talbot), Yarm (Harrison), York (Prest), Middlesborough, Saltburn (Lofthouse), Longroyde Bridge (Varley), Beverley (Dobrée), Thorne (Roberts), Sutton-on-Derwent (Read), Newsome, near Huddersfield (North), Kirkstall (Oates), Holderness coast (Hewetson), Beverley, Lincroft (Hewett), Ripon (Chapman), river Foss, near York (Dutton), Monkton, near Rostoney (Whitaker).

DISTRIBUTION.—Throughout Europe, Asia, Africa, Australasia and Polynesia, but only as a straggler in northern latitudes. [Replaced in America, the Galapagos and Sandwich Islands by the nearly allied *Agrius cingulata*.] AFRICA: Canary Isles (Brit. Mus. Coll.), Madeira (Mathew), Azores (Godman), Algeria (Lucas), Collo (Seriziat), North Morocco (*teste* Bartel), Egypt (Armstrong), Abyssinia (Oberthür), West Africa — Grand Bassam (Harker), Guinea coast (*teste* Bartel), Cameroons (Aurivillius), Southern Nigeria, Sapele (Sampson), Mashonaland—Salisbury, Umtali, 3700ft. (Marshall), Zululand, 1500ft. (Mercer), Transvaal (Ross), Cape Colony (Trimen), Natal—Durban (Leigh), Johannesburg (*teste* Bartel), Eastern Caffraria (Wallengren), Caffraria (Möschler), Moira (Speyer), Nubia (*teste* Bartel), Bourbon, Mauritius, Madagascar (Boisduval). ASIA: Asia Minor—Brussa (Mann), Amasia (Staudinger), Pamir — Osche, Kaschgar (Alphéraky), Aden (Brit. Mus. Coll.), Amurland, very rare—Sutschan (Staudinger), Persia—Turbeth-i-Scheich, Dscham, Astrabad (Bienert), Askhabad (Christoph), Mugan Steppe, Upta (*teste* Bartel), Pamirs (Grumm-Grschimailo), Japan, Fushiki, exceedingly abundant (Lewis), Kamakura, near Yokohama, Chifu, Wei-hai-Wei, Gulf of Pechili, abundant (Fletcher), Hakodate (Leech), Askold (Oberthür), Eastern Thibet — Lob-Nor (Alphéraky), China (Fletcher), Pekin (Speyer), Loun-an-Fou (Alphéraky), Ichang (Leech), Shanghai, Hongkong (Walker), Formosa (Butler), India — North India (Butler), Bengal (Moore), Nilgiris, Calcutta, Manipur, Campbellpore, Masuri, Ceylon (Brit. Mus. Coll.), Karachi, Mhow, Poona, Bombay (Swinhoe), Port Blair (Moore), Sikkim, Bhutan (Dudg.), Haining (Walker), Saugor (Chaumette), Punjab, common (Young), Cutch (Nurse), Further India — Burmah (Butler), Mandalay, Rangoon, Moulmein (Swinhoe), East Indies—Labuan, Java (Brit. Mus. Coll.), Sumatra—Deli (*teste* Bartel), S. Celebes (Snellen), Moluccas — Amboina, Arru (Pagenstecher), AUSTRALIA: Western Australia (Druce), Victoria and New South Wales—Brisbane to Cardwell (Miskin), Sydney (Speyer). NEW ZEALAND: Auckland (Quail). POLYNESIA: Society Islands—Tahiti, Eimeo, Pitcairn Island, &c. (Walker), Fiji Island, New Guinea, New Hebrides, New Caledonia (Druce), Marshall Islands—Jaluit (Rothschild), Philippines, Luzon, Bohol, Mindanao, Cebu (Semper.) AUSTRO-HUNGARY: Taufers Valley, Innsbruck (Weiler), Tyrol (Hinterwaldner), Brenner dist. (Galvagni), Bucovina, not common (Hormuzaki), Pressburg (Rozsay), Bohemia, common in some years (Nickerl), Neu Sandec (Klemensiewicz), Stanislawow (Werchratski), Galicia—Lemberg, Sambor (Nowicki), Brünn (Schneider), Hermannstadt (Czekelius), Eperies, not rare (Husz), Gölnitz (Hudák), Upper Carinthia—Salzburg (Nickerl), Pörtschach (Wagner), Fiume (Mann), Lavantthal, probably the commonest Sphingid (Höfner), St. Lambrecht (Kodermann), Styria—Admont (Kiefer), Pirano (Mathew), Innkreise, not rare—Linz district, &c. (Himsl), Dalmatian Islands —Sesina, Rava (Galvagni), Riva, Gries, near Bozen, Vienna, Carlsbad, Ungarisch-Brod, Moravia, Hungary, everywhere — Neusohl, Rosenau, Kaschau, Raab, Budapest, Heveser and Zipser districts, Debreczen, Transsylvania, Funfkirchen, Mehadia, Dalmatia (*teste* Bartel). BELGIUM: sometimes common, at other times rare, Louvain, common in 1846, Longchamps, common in 1856 (Donckier), Jambes, Warnant, Brussels, Frameries, Bomel, Virton (Derenne), Namur, very common (Lambillion), Marchovelette, Bastogne (Colignon). BULGARIA: Sofia (Bachmetjew), near Varna (Lederer). CHANNEL ISLANDS: Alderney, Guernsey—Les Rocquettes, &c., Sark (Luff). DENMARK: distributed, not rare (Bang-Haas).

France: Hyères district, very common (Powell), Var (Cantener), Aube (Jourdheuille), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir, common (Guénée), Haute-Garonne, everywhere common, even in the high mountains (Caradja), Puy de Dôme, everywhere common (Guillemot), Morbihan (Griffith), Gironde (Trimoulet), Doubs (Bruand), Aude, common (Mabille), Loire-Inférieure—Nantes, common everywhere (Bonjour), Saone-et-Loire, rather common (Constaut), Seine-Inférieure, common — Martin, &c. (Viret), St. Quentin (Dubus), Deux-Sèvres (Maillard), Sarthe (Desportes), Dauphiné—La Grave, at 5500ft., Basses-Alpes—Larche, up to 6500ft. (Tutt), Maas, Moselle, Meurthe districts (Speyer), Normandy—Etretat (Reid), Cevennes — Château-de-la-Caze, Le Rozier (A. H. Jones), Autun (Constant), Brittany — Brest, Paris district, Poitou, Amboise (Réaumur), Belfort — La Chapelle, Rougemont, Rheims (Demaison), Aix-les-Bains (Agassiz), Hérault (Heultz). Finland (Lampa). Germany: everywhere (Heinemann), throughout Prussia but only occasionally (Grentzenberg), northwest Germany, almost everywhere (Jordan), Rhine Palatinate (Bertram), Giessen (Dickore), Lower Elbe district (Zimmermann), Waldeck, generally rare, common in 1846 and 1859 (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich, very common (Kranz), Rudolstadt, common some years (Meurer), Mecklenburg (Schmidt), Bremen, usually rare but occasionally common (Rehberg), Saxon Upper Lusatia, not rare (Schütze), Dresden, not rare (Steinert), Thuringia, common some years (Krieghoff), Erfurt, Gotha, Arnstadt (Knapp), Silesia (Assmann), Upper Lusatia, common (Moeschler), Nassau (Rössler), Wurtemberg, frequently abundant in hot years (Hofmann), Ratisbon (Schmid), Pomerania, rare, Stettiu, some years common (Hering), Rügen, Ober-Mutzkow (Homeyer), Anclam (Tancré), Dessau, common some years (Richter), Alsace (Peyerimhoff), Wernigerode, mostly rare, occasionally common (Fischer), Brunswick, rather rare (Heinemanu), Hanover, often common (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Chemnitz (Pabst), Hildesheim (Grote), Berlin district, somewhat rare (Pfützner), Heligoland (Gätke), Baden, everywhere very common — Constance, Carlsruhe, &c. (Reutti), Lübeck, uncertain (Paul), west Prussia—Kromenhoff, Dantzig, Mecklenburg—Schwerin, Münster-i.-W., Crefeld, Elberfeld, Barmen, Aachen, Cassel, Oberharz, Leipzig, Würzburg, Ratisbon, Munich, Oberstdorf—on the Algäu alp at 2500ft., Kempten, Frankfort-on-Main, Wiesbaden, Friedeberg, Wetterau (*teste* Bartel), Dramburg, sometimes abundaut (Schultz), Fürstenwald-on-the-Spree (Neuburger), Hamburg (Beske). Greece: Arcarnania, Attica (Staudinger), Corfu, common, Vido, &c. (Mathew). Italy: throughout mostly common (Curò), Modena (Fiori), Sicily—Madonie, Palermo, Catania, Ustica, &c. (Minà-Palumbo), Roman Campagna (Calberla), Susa, Turin, Torre Pellice, Bobbie, Au Pra, at 7000ft. (Tutt), Lombardy, Piedmont, Liguria, the Riviera—near Nervi, Sardinia, Tuscany, Naples (*teste* Bartel). Malta (Fletcher). Netherlands: all provinces, usually rare, sometimes common in hot years (Snellen), Breda (Heylaerts), Limburg (Maur), Apeldoorn (Voss). Roumania: very common throughout — Slanic, Grumazesti, &c. (Caradja). Russia: Baltic provinces—very rare, near Riga, Kokenhusen, Wolmar, Windau, Kemmern, Goldingen, Durben, Neu-Autz, Groesen (Nolcken), Livonia, usually rare (Leech), Moscow government (Albrecht), Crimea (Melioransky), Lower Volga district, rare—Sarepta, Aluschta, Ural district—Kasan, &c. (Eversmann), Transcaucasia—Borjom, common, Tiflis, Derbent (Romanoff), St. Petersburg (Erschoff), south Russia (Moeschler), Gorki (Ball), Poland — Kamenez-Podolskii, Jekaterinoslaw, Charkow, Black Sea district—Noworossiisk, Caucasia (*teste* Bartel). Scandinavia: rare, immigrants only—Helsingland (Aurivillius), Scania (Wallengren), Christiania, &c., not infrequent some years (Siebke), Hofby (Thedenius), Kristineberg (E. Ohlsson), Kaknäs near Stockholm (N. C. Ohlsson), Färlöf near Kristianstad (Andersson), Ostergothland (Kindberg), Vestergothland—Venersborg (Hau), southern Norway — Kristianssand (Sandberg). Spain: Andalusia — Malaga (Rambur), Teruel—Ateca (Zapater), Barcelona district—Calella, Pineda, Malgrat (Cuní y Martorell), Catalonia (Martorell y Peña), Bilbao (Rössler), Gibraltar (Walker). Switzerland: everywhere on the south side of the Stelvio up to 7000ft. (Speyer), on the Trift-Clubhut in Gadmenthal at 8000ft. (Rätzer), Weissenburg (Huguenin), Trafoi (Wocke), Grisons (Killias), St. Moritz (Pfaffenzeller), Berne (Benteli), Aigle (Lowe), Zürich (B. Mus. Coll.), Davos-Platz (Sellon), Bergün (Zeller), Bechburg (Riggenbach-Stehlin). Turkey: Crete (Staudinger), eastern Roumelia—Slivno (Lederer).

Tribe: Manducidi.

It has been generally acknowledged among lepidopterists that the Manducids were closely allied to the Sphingids *(sens. strict.)*, but this has not prevented (see *anteà*, iii., pp. 355-357) various authors from placing them in a separate subfamily, and such, at first, was our intention *(loc. cit.*, p. 367), but further study *(anteà*, iv., pp. 264-5) has led us to a different conclusion, and, in spite of the great modification observed in the pupa and imago, we are now inclined to consider the group only of tribal value in the subfamily *Sphinginae (anteà*, p. 263). We have already stated *(loc. cit.*, pp. 264, 273) that the Agriids *(Agrius convolvuli)* and the Sphingids *(Sphinx ligustri)* were not, after all, so very closely allied, and we have placed (pp. 273, 296, 329) their British representatives in two different tribes—*Agriidi* and *Sphingidi*—in spite of the fact that Meyrick and many other authors place such widely different species in the same genus, *Sphinx*, but we were not altogether prepared for Rothschild and Jordan's marvellous innovation *(Revision of the Sphingidae*, pp. 4 *et seq.)*, by means of which they unite our *Agriidi* (under the name of *Herse)*, *Manducidi* (under the name of *Acherontia)*, *Megacorma* (*obliqua*) and *Coelonia (fulvinotata)* under the name *Acherontiicae*, and separate them from the rest of our tribes in *Sphinginae (anteà*, p. 273), which they retain under the name *Sphingicae*, so that, by this arrangement, the Cocytiids and Phlegethontiids (with the exception of *Coelonia)* are brought into close association with the *Sphingidi* and *Hyloicidi*, and are widely separated from the Agriids and Manducids. With this separation, up to a point, we agree, although we are not sufficiently informed to support Rothschild and Jordan's sweeping statement (*Revision*, p. 6) that the species of *Agrius (Herse)* are "all closely allied with one another in structure and pattern. They show close affinities with *Coelonia* and *Acherontia*, and have nothing to do with *Protoparce (rustica)* nor with *Phlegethontius (Cocytius)*." Whilst recognising the necessity for a wider separation of the Sphingids, Agriids, Phlegethontiids, Cocytiids, &c. *(anteà*, p. 273), than has previously been allowed, we still think the Manducids should be dissociated tribally from the Agriids, the Manducids being specialised ovally and larvally in the direction of the *Sphingidi* rather than in that of the *Agriidi*, and in the pupa and imago are quite separate in their specialisations, the structure of the antennæ, maxillæ, legs and abdomen, being quite unique, whilst the wing-shape and scaling are supposed by some authors to be specialised rather in the direction of the Amorphids. It may be well here to note Rothschild and Jordan's argument for uniting the Agriids and Manducids. They write *(Revision of the Sphingidae*, p. 5*)*: "This small tribe is a derivation from the following one *(Sphingicae)*, with which it is closely connected through *Coelonia (fulvinotata)* and *Xanthopan (morgani)*. The relationship between *Acherontia* and the genera with which it is here united in one group has never been noted before. *Acherontia* occupies, in the classification of all authors, quite an isolated position. *Herse (convolvuli)* and *Coelonia (fulvinotata)* have been considered generically identical either with *Protoparce* or with *Hyloicus*, and the Sphingid, here called *Megacorma (obliqua)*, as a near ally of the common oriental *menephron*, standing in Kirby's *Catalogue* under *Meganoton*. When studying the structure of the species

in question we were struck by the great similarity between *Acherontia* and the Ethiopian Sphingid, *Coelonia fulvinotata*. In fact, *Acherontia* is nothing else but a derivation from *Coelonia;* it is a *Coelonia* with a short and stout tongue.* This conclusion, derived from the comparison of the structure and the wing-pattern, is borne out by the caterpillar, which has, in both *Acherontia* and *Coelonia*, the well-known tubercular -shaped horn. *Coelonia* shows close affinities in the pattern and structure of the imago with *Xanthopan* . . . a genus of *Sphingicae*, in which even the peculiar structure of the inner surface of the second palpal segment is indicated rudimentarily, and the relationship of *Xanthopan* with other genera of *Sphingicae*, *e.g.*, with *Panogena* and *Cocytius* is unmistakable. We have, therefore, a gradation from the *Sphingicae* through *Xanthopan* and *Coelonia* to *Acherontia*, the latter being the most highly specialised of this series. *Herse (convolvuli, cingulata, &c.)* is an offshoot from this branch, and so is *Megacorma (obliqua)*, both of which agree with the other two genera of *Acherontiicae* closely in the specialisation of the second palpal segment. In *Herse* and *Acherontia* a further specialisation obtains, which is largely observed again among the *Sphingicae*, *viz.*, the reduction of the pulvillus of the tarsal claw-segment. The paronychia, too, lose their ventral and long lateral flaps in *Acherontia*. The humped thorax of the larva of *Coelonia* is very significant. We shall see that among the lower *Sphingicae*, from which the *Acherontiicae* are derived, a similar structure of the larva occurs." We do not ask for a better justification than this of our table *(anteà*, p. 273). We have there isolated the *Agriidi (Herse)* from the *Sphingidi Phlegethontiidi* and *Cocytiidi*, and Jordan distinctly *(suprà)* places *Coelonia fulvinotata* (a species that we have hitherto considered a Phlegethontiid) as an ally of the more specialised *Manducidi* on the one side and the *Cocytiidi* on the other. The only real differences between us and these authors appear to be largely the terminology employed, and the degree of relationship to be admitted.

We have already discussed *(anteà*, pp. 264 *et seq.)* our views of the Manducid relationships. The larva is structurally more distinctly Sphingid than Agriid, witness the similarly swollen thoracic segments, the Sphinx attitude, &c. The pupa is distinctly allied to that of the Cocytiids, agreeing in form, outline, callosities and spiracular flanges, but specialised away from them in that the long proboscis-case has receded† again, and is now soldered throughout its length, preserving a file-like rough area, representing the proboscis-horn of the higher Sphingids, the rest of the maxillæ being, as in them, smooth, whilst the peculiar imaginal specialisations of the antennæ, maxillæ, legs, abdomen, and wing-scaling have been repeatedly noticed. For Chapman's definition of the group reference must be made to vol. iii., p. 367.

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* Chapman observes *(anteà*, p. 264) that, pupally, *Manduca* is an *Amphonyx (i.e., Cocytius)* in which the proboscis-case has receded again.

† Réaumur expresses (*Mémoires*, ii., p. 296) his astonishment at the length of the pupal maxillæ compared with the length of the imaginal tongue, and says: "La trompe paroissoit aussi longue et aussi effilée que les trompes plates, qui se roulent en un grand nombre de tours, . . . mais apparemment que, lorsque la trompe se tire de ses enveloppes, elle se raccourcit, et qu'elle grossit de ce

The tribal name, *Manducidi*, is derived from Hübner's *Manducae* (*Tentamen*, p. 1), the oldest group name of the tribe, and of which he notes *Manduca atropos* as the typical genus and species. Some 16 years later he used (*Verz.*, p. 139) the term to include the whole of the *Sphingidae* (*sens. strict.*) (see, *antea*, iii., pp. 351-2), placing *atropos*, Linn., *chionanthi*, Abb., and *morta*, Hb. (*atropos*, Cram.) in Laspeyres' genus, *Acherontia* (which all subsequent authors, however, referred to Ochsenheimer). The name *Acherontiinae*, used by Rothschild and Jordan as equal to our *Sphingidae*, appears to us to have no standing whatever as against the old subfamily name *Sphinginae*, derived from the Linnean name *Sphinx* and in which the whole superfamily was first included, and we find the remarkable anomaly (*Revision of the Sphingidae*, pp. cxxxv) of a family *Sphingidae*, subfamily *Acherontiinae*, tribe *Sphingicae*, and no typical subfamily *Sphinginae* among the whole of the Sphingids.

We restrict the tribe to one genus, *Manduca*. Grote considers (*Ent. Rec.*, vi., p. 233) that the tribe appears, from all the characters, to have reached a stage of evolution, precluding the idea of further advance or development in its own particular direction. He says that the short antennæ, the great development of the muscles of the thorax, the comparatively broad and short wings, the adaptation of the tongue to feeding upon honey gathered by other insects, and other features seem to have attained a certain completeness of expression which, while pointing to an extended antecedent history, appears to warrant the view that the Manducids are the last of a long line.

Genus: MANDUCA, Hübner.

SYNONYMY.—Genus: *Manduca*, Hb., "Tent.," p. 1 (1806); "Franck Cat.," p. 87 (1825); Kirby, "Cat.," p. 700 (1892); "Handbook," &c., iv., p. 51 (1897); Tutt, "Brit. Lep.," iii., p. 355 (1902). *Sphinx*, Linn., "Syst. Nat.," 10th ed., p. 490 (1758); 12th ed., p. 799 (1767); "Mus. Ludov. Ulr.," p. 348 (1764); Poda, "Ins. Mus. Græc.," p. 81 (1761); Scop., "Ent. Carn.," p. 184 (1763); Hufn., "Berl. Mag.," ii., p. 176 (1766); Cram., "Pap. Exot.," i., pl. lxxviii., fig. A (1775); Fab., "Syst. Ent.," p. 539 (1775); "Spec. Ins.," ii., p. 144 (1781); "Mant. Ins.," ii., p. 95 (1787); "Ent. Sys.," iii., pt. 1, p. 364

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dont elle devient plus courte." Chapman notes (*Ent. Record*, xiv., p. 128) an imago of *M. atropos* that has a proboscis, one-half of which is much longer than is normal, the other much shorter. He points out that the normal length of the proboscis is about 16mm., and in the one under examination 21mm., and goes on to discuss its phylogenetic meaning. He notes that the pupal proboscis is 40mm. long, the imaginal only 16mm., and adds: "The pupal proboscis is the imaginal proboscis at a certain stage of its development, all that is purely pupal is the chitinous sheath that is left behind when the imago emerges. In the early pupal stage, then, the proboscis of *M. atropos* is 40mm. long, but, beyond a layer of almost embryonal hypodermic cells and some nervous and tracheal cords, it is almost without structure; when the structure characteristic of the imago begins to develop, it does so throughout the whole 40mm. of pupal structure. The extremity of the proboscis develops at the end of the 40mm., and, as development progresses, at least towards the end of the process, the proboscis leaves the pupal sheath and shortens by contraction affecting its whole length, to the imaginal dimensions, the vacant space being temporarily filled with fluid. The basal 16mm. of the pupal proboscis does not develop into the imaginal proboscis and the remaining 24mm. do nothing. The aberrant specimen examined shows the process of contraction from the early pupal to the imaginal dimensions arrested at a particular point, probably as a result of some injury to the pupa, acting, perhaps, in some degree mechanically, and in some measure as a cause of diminished vitality."

(1793); "Ill. Mag.," vi., p. 288 (1807); [Schiff.,] "Schmett. Wien.," ed. 1, p. 41 (1775); ed. 2, p. 11 (1801); Harris, "Engl. Lep.," p. 30 (1775); Esp., "Schmett. Eur.," i., p. 27, ii., p. 69, pl. vii (1779); Bergstr., "Sphing. Eur. Larv.," p. 6 (1782); Bkh., "Sys. Besch.," ii., p. 88 (1789); "Rhein. Mag.," p. 318 (1793); Cuv., "Tabl. Elem.," p. 592 (1798); Donov., "Brit. Ins.," ix., p. 3, pl. 289 (1800); Hb., "Eur. Schmett.," i., pl. xiii., fig. 68 *(circ.* 1800); text, p. 98 (1805); "Larvæ Lep.," ii., Legit. C *a (circ.* 1800); Schrk., "Faun. Boica," ii., pt. 1, p. 224 (1801); Haw., "Lep. Brit.," i., p. 56 (1803); Latr., "Hist. Nat.," iii., p. 401 (1802); xiv., p. 130 (1805); "Gen. Crust.," iv., p. 210 (1809); Ochs., "Die Schmett.," ii., p. 231 (1808); Leach, "Ency. Edinb.," ix., p. 131 (1815); Dalm., "K. Vet. Ak. Handl.," p. 213 (1816); Sam., "Ent. Comp.," 244 (1819); Godt., "Hist. Nat.," iii., p. 16, pl. xiv (1820); Evers., "Faun. Volg.-Ural.," pp. 108, 113 (1844). *Atropos*, Oken, "Lehrb. Zool.," i., p. 762 (1815). *Sphynx*, Vogel, "Sch. Cab.," i., p. 22, pl. iv., figs. 4 *a-b* (1821); Heulz, "Bull. Soc. Ent. Fr.," 1887, p. 7 (1887). *Spectrum*, Billbg., "Enum. Ins.," p. 83 (1820). *Acherontia*,* Lasp., "Jena. Allg. Lit. Zeits.," iv., p. 99 (1809); Ochs., "Die Schmett.," iv., p. 44 (1816); Hb., "Verz.," p. 139 *(circ.* 1822); Stphs., "Illus.," i., p. 114 (1828); iv., app. p. 5 (1835); "Cat. Br. Ins.," ii., p. 31 (1829), "List Br. An. Brit. Mus.," v., p. 27 (1850); Meig., "Eur. Schmett.," ii., p. 146 (1830); Wood, "Ind. Ent.," p. 12, fig. 10 (1839); Westwood, "Gen. Syn.," p. 88 (1840); Bdv., "Gen. et Ind. Meth.," p. 49 (1840); "Spec. Gén. Lép. Het.," i., p. 5 (1875); Dup., "Cat. Meth.," p. 43 (1844); Humph. & Westd., "Brit. Moths," p. 9, pl. ii., figs. 1-3 (1842); Rbr., "Faun. And.," p. 331 (1842); Assm., "Schm. Schles.," ii., p. 40, pl. xvi.—xvii., figs. 41 *a-g* (1845); H.-Sch., "Sys. Bearb.," ii., p. 90 (1846); Heydenr., "Lep. Eur. Cat. Meth.," p. 18 (1851); Sta., "Man.," i., p. 88 (1857); Speyer, "Geog. Verb.," i., p. 323 (1858); Hoeven, "Tijds. Ent.," ii., p. 11 (1859); Hein., "Schmett. Deutsch.," p. 149 (1859); Humph., "Gen. Brit. Moths," p. 8 (1860); Staud., "Cat.," ed. 1, p. 16 (1861); ed. 2, p. 36 (1871); ed. 3, p. 98 (1901); Wallgrn., "Skand. Het.," p. 20 (1863); Snell., "De Vlind.," pp. 99-100 (1867); Berce, "Faun. Franç.," ii., p. 11 (1868); Nolck., "Lep. Fn. Estl.," i., p. 86 (1868); Newm., "Brit. Moths," p. 5 (1869); Bang-Haas, "Nat. Tids.," (3), ix., p. 402 (1874); Cuní y Mart., "Cat. Lep. Barc.," p. 37 (1874); Mill., "Cat. Lép. Alp.-Mar.," p. 116 (1875); Curò, "Bull. Soc. Ent. Ital.," vii., p. 109 (1875); Butl., "Tr. Zool. Soc. Lond.," ix., p. 598 (1877); Kirby, "Eur. Butts. and Moths," p. 67 (1879); Frey, "Lep. Schweiz," p. 56 (1880); Moore, "Lep. Ceylon," ii., p. 5 (1882); Rom., "Mém. Lép.," i., p. 69 (1884); Lampa, "Ent. Tids.," vi., p. 26 (1885); Poulton, "Trans. Ent. Soc. Lond.," 1886, pp. 143 *et seq.* (1886); Buckl., "Larvæ," &c., ii., p. 107, pl. xxi., fig. 1 (1887); Auriv., "Nord. Fjär.," p. 44 (1889); Mina-Pal., "Nat. Sic.," vii., p. 41 (1889); Meyr., "Handbook," &c., p. 299 (1895); Barr., "Lep. Brit.," ii., p. 16 (1895); Tutt, "Brit. Moths," p. 17 (1896); Morres, "Notes on Ach. atropos," pp. 1-25 (1897); Riedel, "Illus. Zeits. für. Ent.," iii., p. 55 (1898); Aigner-Abafi, loc. cit., p. 337 (1898); iv., pp. 3-355 (1899); v., p. 36 (1900); Bartel, "Pal. Gross-Schmett.," ii., pp. 16-17 (1899); Siepi, "Feuilles des J. Nat.," xxxiii., pp. 104-5 (1903); Roths. & Jordan, "Revis. Sphing.," p. 18 (1903). *Brachyglossa*, Bdv., "Eur. Lep. Ind. Meth.," p. 33 (1829); "Icon. Chen.," pl. viii., figs. 1-3 *(circ.* 1840); Dup., "Hist. Nat.," supp. ii., p. 182 (1835); "Icon. Chen.," pl. vi *(circ.* 1840).

The genus *Manduca* was erected by Hübner in 1806 (*Tentamen*, p. 1) when the type was cited as *atropos*, the species having been previously figured and described by him as imago and larva (*Eur. Schmett.*, fig. 68, text p. 98; *Larvae Lep.*, ii., Legit. C.a) so that

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* The generic name, *Acherontia*, has been referred to Ochsenheimer for nearly a century. We, therefore, give the following: "Laspeyres *(Jena. Allg. Lit. Zeit.*, vi., 4, p. 100), in reviewing vol. iii of Ochsenheimer's *Schmetterlinge von Europa*, says: 'The fourth family [of Ochsenheimer's *Sphinx*] needs dividing into two separate genera; to the former, for which the reviewer retains the generic name *Sphinx* (since it contains those species whose larvæ, by the peculiar posture which they assume, occasioned the naming of the whole assemblage of more or less similar species), are to be referred *convolvuli, ligustri* and *pinastri;* to the other, which might bear the name *Acherontia—atropos.* Build of antennæ, tongue and a number of other essential characters, not only mark out *atropos* (besides some exotic species) as a separate genus, but separate it even sharply from the other species with which Herr Ochsenheimer has united it.'" (Prout).

there can be no doubt as to the species for which *Manduca* was intended, and it may be well to note that Ochsenheimer, in 1816, recognised (*Die Schmett.*, iv., p. 44) that *Acherontia* was a synonym of *Manduca*, both generic names having been created for *atropos*. Rothschild and Jordan reject the name because it is undescribed, although they do not state that they fail to recognise the species for which the generic term was created. These authors describe (*Revision of the Sphingidae*, pp. 16-17) the genus (under the name of *Acherontia*) as follows:—

♂ ♀. Tongue short, very thick, hairy, opening before end large, dorsal. Palpi not touching each other, second segment a little shorter than the first; carina of clypeus and base of tongue visible. Antenna thick, much shorter than the forewing is broad at its widest point. Body very stout. Legs short and stout; anterior tibia short, a little longer than the cell of the hindwing is broad; spur reaching end of tibia; lateral spines of anterior tarsus heavy; middle and hinder tarsi strongly compressed, spines heavy; two ventral rows, besides an interno-lateral row of shorter ones, and a number of dorsal and subdorsal spines representing the fourth row; these latter spines, fewer in number and gradually more ventro-lateral on the distal segments; no comb of prolonged spines; posterior tarsus as long as the cell of the hindwing. Pulvillus absent, paronychium reduced to a short broad lobe. Scaling of body and legs (inclusive of spurs of mid and hind tibia) woolly; scales of the upper layer of the forewing multidentate, the teeth long and thin, especially on the undersurface, the scales of the hindwing longer, narrower, partly hair-like, the broader ones deeply slit and long-toothed. ♂ Tenth abdominal tergite long, slender, pointed, the same in the three species of the genus; harpe with two processes or teeth; clasper sole-shaped, with a patch of large multidentate friction scales. Penis-sheath, long and thin, without armature. ♀ Aperture of vagina with an elliptical rim; eighth tergite shallowly sinuate. *Larva*: With tuberculated horn, which is horizontal with the end recurved; horn ~ -shaped. *Pupa*: Without free tongue-case—Type *atropos*.

The three species*, included in the genus, are diagnosed by Rothschild and Jordan (*Revision of the Sphingidae*, p. 17) as follows:

a. Hindwing above with a large black patch in basal half—*A. lachesis*.
Hindwing above with the basal half yellow . *b*
b. Abdomen beneath with black segmental bands *A. atropos*.
Abdomen beneath without black segmental bands, only with small black mesial spots *A. styx*.

For comparison we add Bartel's table (*Pal. Gross-Schmett.*, ii., p. 17), which reads as follows:

I. The black transverse stripes of the abdomen join on the ventral side.
a. Basal area of hindwings unicolorous yellow, always without dark transverse stripes *A. atropos, L.*
b. In the basal area of the hindwings stands a thick dark spot *A. lachesis, F.* (*satanas, B.*).
II. The black transverse stripes of the abdomen do not join on the ventral side. *A. styx*, Westd. (*medusa*, Butl.).

Few as are the species in the genus they are distributed throughout Africa (*atropos*), Europe (*atropos*), western Asia (*atropos*), south-eastern Asia (*styx*), and the East Indies (*lachesis*). Grote notes (*Ent. Record*, vi., p. 233) that the genus has erroneously been reported from Mexico, but that it is peculiar to the Old World.

* Huwe maintains (*Berl. Ent. Zeits.*, xliv., Sitz. p. 54) the distinctness of *styx*, Westd., and *medusa*, Btl. On the other hand, Staudinger sinks (*Cat.*, 3rd. ed., p. 98) both *styx*, Westd., and *medusa*, Btl., as specifically identical with *atropos*, Linn.

Manduca atropos, Linné.

Synonymy.—Species: *Atropos*, Linn., "Syst. Nat.," xth ed., p. 490 (1758); xiith ed., p. 799 (1767); "Mus. Ludov. Ulricæ," p. 348 (1764), &c. *Solani*, Oken, "Lehr. Zool.," i., p. 762 (1815). [Note.—With the exception of this reference to Oken, all others noted in the generic synonymy *(anteà* pp. 395-396) are referable to the specific name *atropos.*]

Original description.—*Sphinx atropos*, alis integris: posticis luteis fasciis fuscis, abdomine luteo maculato: cingulis nigris. Amoen., *Acad.*, 3, p. 321. Caput mortuum. Alb., *Ins.*, t. 6., Réau., *Ins.*, 2, t. 24, l. 14, f. 2. Osbeck, *It.*, 89. Wilk., *Pap.*, 9, t. 1, B. 1. Hasselqu., *It.*, 417, n. 104, 105. Roes., *Ins.*, 3, t. 1-2. Habitat in Jasmino. Europæ, Ægypti duplo major et Indiæ (Linné, *Sys. Nat.*, xth ed., p. 490). [He further adds: "Alæ superiores nigricantes puncto albido" *(Sys. Nat.*, xiith ed., p. 800).]

Imago.—90 mm.—120 mm. Thorax black, with characteristic skull and cross-bones ochraceous; abdomen orange-yellow with black segmental rings and a wide mediodorsal longitudinal blue-black (grey shaded) line. Anterior wings velvety-black, marbled with rich brown and sprinkled with grey scales; an incomplete pale ochreous wavy transverse basal line, a double black transverse line just within; a double black wavy angulated line beyond the middle, outside which is a pale subterminal edged internally with black; a small round pale discoidal spot edged with black, outside which is a median black transverse shade, a grey oblique apical patch; a series of marginal ochraceous-brown interneural streaks with a small rounded patch at anal angle. Posterior wings orange-yellow with two black transverse bands united by black neural lines which also extend from outer band to outer margin.

Sexual dimorphism.—Within the limits of the series examined, although considerable variation is shown in size, and some little in build and colour tone, no sexual difference in any of these respects makes itself evident, but the female seems to be the larger and to carry the full width of the abdomen further to the last segment, but, so far as size is concerned, the individual variation is so great as to make this doubtful. The yellow markings of the abdomen seem more pronounced in the female, perhaps because the abdomen is rather wider, at least in the later segments. The male antennæ measure about 15·5mm. in length (without straightening the final hook), the female about 13.5mm. The slipper arrangement of hairs on the male antennæ is a little modified from the usual disposition in so far that the distal row of hairs is less complete than the proximal, so that each little pocket has its opening facing more towards the apex of the antenna and less towards its venter than usual. On the female antenna are a set of fine reddish hairs, disposed almost exactly as in the male antenna, *i.e.*, the ordinary short hairs of the female antenna are distinctly longer and more pronounced along the basal margins of the segments (where the male hairs are more developed) and against the scaled portions, so that, though not comparable with the male hairs in length, they much exceed the other sense-hairs of the antenna and contrast with the usual short sense-hairs of the female antenna. The scaling is very irregular, the terminal row of scales to a joint is distinguishable, and, on the terminal joints of the female antenna, a certain

amount of regular alignment affects the other scales, but even then it is not easy to say that they fall into two other rows. The male antenna is of about equal thickness, 1·0mm., from the 10th to the 35th joint, the female is only about 0·7mm. in thickness and does not reach this till about the 13th or 15th joint, the terminal bend and tassel consist of about 15 joints. The fore tibia and its spur are approximately identical in the two sexes; the chitinous surfaces of these first tibial spurs are covered with fine spicules, varying from the spines of the comb to hair-like and scale-like structures, which are very beautiful. The male scent fan* is very well developed, it arises from the margin of the ventral plate of the 1st (2nd)† abdominal segment over a length of rather over a millimètre, it is very dense, composed of reddish-orange hairs, 5mm.-6·5mm. in length. These are concealed in an unusually large pocket, in its own and the following segment, consisting of a deep groove, formed by a depression of the margin of the ventral plate, which is covered by a reflexion inwards of the margin of the dorsal plate. The palpi of *M. atropos* have a structure which is almost exactly the same as is found in *A. convolvuli*, and which I find also in *A. cingulata* and another closely related Agriid. It appears to be present in the species of *Manduca*, but I cannot find it in any other Sphingid species that I have been able to examine. The inner face of the 2nd joint in *M. atropos* has a central basal portion, convex and unclothed, this occupies about $\frac{2}{5}$ of the length; beyond this is a rather deep circular hollow, from the basal margin of which arises a row of rather flat scales which arch over the hollow, forming a dome-like roof over the hollow, and which meet together at its further margin. It is this fan-like dome that is seen on looking at the inner surface of the palpus. In *A. convolvuli* this dome of scales is even more beautifully elaborate. It arises nearer the base of the joint, the portion basal to it is scaled and slopes down to it. The origin of the fan-like dome of scales is of very regular circular outline, as is the whole dome, although the scales converge to a point at the concave (upper) margin of this joint, the hollow beneath the dome extends beyond it to the end of the joint and is thus not circular (though the dome is). The dome of scales thus occupies about the centre of the inner face of the joint, but rather nearer base. The hollow is unclothed (Chapman).

GYNANDROMORPHISM.—Only one gynandromorph of this species is known to us. This is described as follows:

a. The left side in comparison with the right betokens the ♀ sex in that it has a somewhat smaller antenna, and a shortened abdominal point; otherwise the specimen is ♂ (Taschenberg, *Zeits. f. d. ges. Naturwissenschaften*, xxii., pp. 520-521).

VARIATION.—The variation of this species has sometimes quite a teratological basis. Such variation as that of the shape of the

* Bartel notes *(Pal. Gross-Schmett.*, ii., p. 22): "In the ♂, on each side of the 1st abdominal segment, is seen a deep pocket, from which, in flight, a whole fan of long, strongly-scented, yellow hairs can be thrown. When the ♂s have been killed, this scent-apparatus is only very rarely visible. One can, however, see the verticillate tuft of hairs if one so holds a living ♂ by the abdomen, that the underside of the abdomen is turned upwards and the wings can be moved."

† We have previously noted that the 1st abdominal segment is nearly obsolete and that the apparent 1st is really the 2nd segment.

wings is distinctly of this character. A long series, bred by Burrows in 1896 and 1900, exhibits considerable variation. In some examples, the costa of the forewing is much more hollowed, in others more convex than in normal examples; the apices of the forewings, too, are rounded in the least pigmented specimens; sometimes, too, the outer margin is distinctly angulated; in others, again, the wings are distinctly narrower, whilst some examples have the outer margin of the hindwings quite hollow. There is also considerable variation in the tint of the skull-mark on the thorax; in some specimens the colour of this is whitish-grey, in others dark grey, in others ochreous; in the more extreme cases it becomes deep brown, whilst in a few examples the mark is only faintly traceable, having blended, as it were, with the ground colour. We would designate those examples in which it is practically absent as ab. *obsoleta*, n. ab. The anterior edge of this mark, too, is exceedingly variable, in some specimens forming a simple convex curve, in others a series of three small curves, in others, again, being angulated or pointed. The abdomen varies in tint from pale yellowish to darker orange, which, in some, inclines to brownish. The black longitudinal streak down the centre of the dorsum of the abdomen is also much broader in some specimens than others. On the forewings the basal marking is in some individuals distinctly double, and traceable to the inner margin, in others only the inner line is shown, and this does not reach the inner margin of the wing, whilst in some the marking is concolorous with the rest of the wing. The angulated line, which extends occasionally from the costa to the inner margin, is pale; usually it is not to be traced in the inner half of its course. The subterminal is less distinct, but very variable in intensity. The brown colouring, extending from the costa along the upper half of the wing to the centre, is very much developed in some specimens, almost absent in others. In three or four examples the wings are badly scaled at the tips, the rest of the wings being unicolorous, blackish. The central spot is very much larger in some specimens than in others. In the hindwings the neural darkening between the two bands is very variable in intensity, sometimes rather closely uniting the two bands. The basal half of the inner band may be strong or weak, or obsolete. The outer band is sometimes weak apically; the black inclining to greyish, in one specimen, forced in 1893, the left hindwing has a pale, almost obsolete, inner band (*Trans. City Lond. Ent. Soc.*, vii., pp. 3-4). At the meeting of the Berlin Ent. Soc., held November 23rd, 1899, Huwe exhibited examples without the inner band of the hindwings, and also some melanic ones, whilst one had the rings of the abdomen almost obsolete and silver-whitish stripes thereon. The most common forms of variation in the character of the bands of the hindwings are (1) The inner band wanting=ab. *imperfecta*, n. ab. (2) The two bands closely united = ab. *conjuncta*, n. ab. (3) The outer band continued to the margin = ab. *extensa*, n. ab. Nickerl mentions that he has aberrations with the inner band of the hindwing wanting, and Assmann figures (*Schm. Schles.*, ii., pl. xvii., fig. e) the aberration mentioned by Ochsenheimer (*Die Schmett.*, ii., p. 284) without the inner band of the hindwings; Gauckler records (*Illus. Zeits. für Ent.*, v., p. 282) breeding a similar one at Carlsruhe, in 1900, and another not more than half the size of

normal examples. Rothschild and Jordan write (*Revision of the Sphingidae*, p. 21) of the variation of this species: "The forewing is occasionally nearly all black, with the lines obscure and the white or ochraceous scaling in the subapical region obliterate; on the other hand, there occur individuals with an unusually large ochraceous subapical patch. The discal band of the hindwing is sometimes absent or vestigial; the outer band is also occasionally obsolescent. Seldom are both bands nearly fused into one, more often is the external one so enlarged distad that the yellow marginal spots are reduced to dots. The amount of black on the underside of the wings is not rarely absent or vestigial, the stigma of the hindwing is sometimes wanting. The skull-mark of the thorax is very seldom absent. The black segmental bands of the abdomen below are complete, and never reduced to mesial spots. Some individuals have the underside of the abdomen nearly all black; in others, especially often in bred ones, the undersurface of the body is fuscous, in which case neither the yellow nor the black bands are clearly defined. On such individuals as the latter, Leech's assertion (see *infrà*) that these black bands are sometimes quite absent from the abdomen of *atropos* may have been based. We do not find any difference in structure or colour between the Ethiopian and Palæarctic *atropos*, but the tropical specimens are, on an average, especially in the ♂ sex, smaller than the northern individuals; we say expressly on an average, as many Ethiopian examples surpass the medium-sized Palæarctic ones." It may be well here to note that Leech (*Proc. Zool. Soc. Lond.*, 1888, p. 587) unites the eastern *medusa*, Btl., with *M. atropos*, whilst Jordan and Rothschild as strongly affirm it a variety of *styx*, Westwood, which they treat as specifically distinct from *M. atropos*. Leech writes (*loc. cit.*, p. 587): "Neither Chinese nor Japanese representatives are to be separated with certainty from *A. atropos;* however, the more slender abdominal belts and transverse stripe, together with the darker 'skull-mark' on the thorax, of most of the specimens from China and Japan, afford fairly good varietal characters, and, as these seem to be pretty constant, it will, perhaps, be well that this form be known as var. *medusa;* I should note that among my European specimens of *A. atropos* are individuals with the 'skull-mark' quite as dark as in any Japanese or Chinese example." Writing the next year of Chinese examples, he sinks both *styx* and *medusa* as synonyms of *atropos*, and says (*Trans. Ent. Soc. Lond.*, 1889, p. 118): "Five specimens from Kiukiang agree with the Japanese examples. Absence of the black bands on the undersurface of the abdomen, by which it is claimed *medusa* and *styx* may be separated from *atropos*, is not a trustworthy character, as, in some European specimens, these bands are not present on the ventral surface, whilst some Chinese and Japanese examples exhibit traces of such bands." In 1898, he maintains (*op. cit.*, 1898, p. 275) this position, and adds that "the characters given by Hampson as distinguishing *styx* from *atropos* appear to be of little specific value. . . *Medusa*, Btl., from Japan, has no constant character to separate it from the Indian form." As we have already noted, Staudinger and Rebel (*Cat.*, 3rd ed., p. 98) do not distinguish specifically between the three forms, treating *styx* as a variety of *M. atropos*, and *medusa* as a synonym of *styx*. Needless to say none of

those who unite the three insects have examined them in the same critical manner as have Rothschild and Jordan. We append the original descriptions of *styx* and *medusa*, which read as follows :

(1) STYX, Westd., "Cab. Orient. Eut.," p. 88, pl. xlii., fig. 3 (1848).—*Sphinx* (*Acherontia*) *styx*. *Sphinx* alis anticis fuscis, plumbeo irroratis nigroque variegatis et undatis, apiceque luteo et ferrugineo magis variis, stigmato parvo luteo, undulis albidis pone medium ad costam magis conspicuis; alis posticis fulvis, fasciis duabus nigricantibus; prima, angusta mediana; secunda, utrinque dentata submarginali; corpore fusco, thorace supra lateribus plumbeis utrinque strigis duabus nigris; figura dorsali faciei coloris fusci fere uniformis, oculis parvis nigris, postice lunula nigra (striam curvatam plumbeam includente) cincta; abdomine fulvo; segmento singulo macula parva quadrata plumbea dorsali incisurisque fuscis; [abdomen subtus fulvo, punctis duobus mediis parvis rotundis nigris (nec nigris fasciatis ut in *S. atropos*);]* pedibus angustis luteo annulatis. Exp. forewings $4\frac{1}{8}$ins. East Indies. From Col. Hearsey. This species is most nearly allied to *Sphinx atropos*, but differs from it in its smaller size, in the uniform colour of the face-like marking on the back of the thorax, and in the slenderness of the limbs (Westwood). The larva is very pale greeu, or bright golden-yellow, irrorated with black dots, with lilac-bordered oblique white streaks. It has also a dark brown form. It feeds on *Paulownia imperialis*. North India (James), Turkey in Asia (Loftus) [Westwood].

(2) MEDUSA, Butler, "Trans. Zool. Soc. Lond.," ix., pp. 597-598 (1877).—Altogether darker than the preceding (*styx*), and runniug to a larger size; primaries above without or with very indistinct longitudinal reddish streaks; subapical paler area less oblique, the intersecting transverse lines less strongly dentated; secondaries with black bands, as a rule, closer together, better defined, the inner one generally extending to third subcostal branch; body above darker, the skull-marking on thorax much darker, and consequently rather less conspicuous; head blacker; abdomen with the dorsal blue bar darker, the transverse bands blacker; primaries below the outer border much more dusky; secondaries with the outer band more dusky. Expanse of wings, 3in. 5 lines to 4in. 10 lines (*A. styx* measures 3in. 2lines to 4in. 5 lines). Java (Horsfield), Hong Kong (Bowring); Shanghai, China, East India, Philippines (Bowring). I have received examples of this species from Mr. Lewis. The smaller form of it was bred by him in Japan, and as he has had the transformations carefully drawn by a native artist, I am now enabled to figure them proving the entire distinctness of this species from *A. atropos*. He believes that the larger examples may be referable to a distinct species, the small Japanese examples being constant in size and in the absence of the ventral black spots upon the abdomen. The larva feeds on *Sesamum orientale* (Butler).

Bartel says (*Pal. Gross-Schmett.*, ii., p. 23) that striking aberrations are rare. He observes that he has seen examples of our ab. *imperfecta* in both sexes, and further notes that transitions between this form and typical examples occur, some specimens even having the inner band present on one side, but absent on the other. He further remarks that Wiskott has an example, bred in Berlin, of our ab. *obsoleta*, in which the characteristic thoracic marking is completely wanting, only a small black spot being present in the middle of the thorax. In the Kricheldorf collection is an example in which the inner band of the hindwing is almost entirely connected with the outer band by black scaling (evidently a specimen of our ab. *conjuncta*) the black colour being even more extended, and having a more striking appearance on the underside of both wings, the outer half being entirely black-scaled. Bartel adds: "European examples are, on an average, larger than exotic. Rössler sees in this a confirmation of the well-known

*The piece enclosed in square brackets [ ] is added in MS. in Westwood's handwriting in his own copy of the work, now in the Natural History Museum at South Kensington.

Plate II.

Aberrations of Manduca atropos.

rule that, in colder climates, slower development leaves more room for growth. The contrary is asserted by other authors. I can only mention in this connection that the examples, forming a series from Natal, which I saw a short time since, were considerably smaller and also more weakly marked than Central European specimens." There is much variation in the amount of pale marbling of the forewings, some examples having a distinctly variegated appearance, others being uniformly blackish-brown, with the ordinary paler markings obsolete. These forms may be grouped as:

1. Forewings uniform blackish-brown, transverse markings indistinct, pale markings obsolete=*atropos*, Linn.

2. Forewings marked with distinct transverse markings; pale markings well-developed=ab. *intermedia*, n. ab.

3. Forewings with the basal, median and outer areas very dark; the basal and angulated lines pale, giving the general idea of the wing being divided into three dark transverse bands—basal, median and outer—the apical area more normal, pale blotch on outer margin just below apex; discoidal spot conspicuous in median area=ab. *virgata*, n. ab.

4. Forewings with all the light markings double the usual size; the normally dark parts considerably lighter, the whole insect dusted plentifully with white scales =ab. *variegata*, n. ab.

As to the variation of the hindwings, Miss Miller records (*Ent. Rec.*, xiv., p. 183) a specimen, bred in the autumn of 1901, which has the "outer band of the left hindwing very wide, and almost touching the inner band. The outer edge of the wing itself has two curves instead of one. Otherwise the moth is quite perfect and in no way crippled." Thorpe states (*Ent.*, v., p. 143) that he reared "a very large ♀ having only one black band instead of two on the hindwings, the inner band being entirely absent" (=ab. *imperfecta*). There is also some variation in the hue of the hindwings. Their normal tint is of a deep orange colour, sometimes, however, much suffused with black scales; rarely the colour is quite pale yellow (ab. *flavescens*, n. ab.), and intermediate tints occur, apparently with no trace of fading. There appear to be no really well-differentiated races of this species (if *medusa* and *styx* be considered distinct species), and Rothschild and Jordan state that, having examined the type of Kirby's *sculda*, they find it to be an individual of *M. atropos*, and that the habitat "Borneo" is erroneous. Kirby says (*in litt.*) that the locality labels of many of the Sphingids (received from the same source as this type) in the Dublin Museum, are very unreliable, and he assents to the probability of Rothschild and Jordan's conclusion being accurate. He states, however, that the specimen is quite aberrational, so we append the original description. This reads as follows:

SCULDA, Kirby, "Trans. Ent. Soc. Lond.," 1877, p. 242 (1877); "Cat.," p. 700 (1892); Waterh., "Aid Ident. Ins.," ii., pl. 141, fig. 2 (1884).—Exp. al. $4\frac{3}{4}$in. Forewings as in *medusa*, Butl., but less strongly dusted with grey; a reddish space along the middle of the inner margin. Hindwings straw-colour, hind-margin black, with yellow spots between the nervures on the outside but much smaller than in any other species; a narrow black line within, curving towards the anal angle. Head and thorax as in *medusa*, a large black spot on each cheek of the skull. Abdomen with a very broad central bluish-black stripe, covering nearly the whole abdomen towards the extremity; a broad black band on each segment, broadest below, where it occupies as much space as the yellow, except just towards the tip. Underside of forewings yellow, with a black border and two obsolete transverse black lines, wider apart than in *medusa*; hindwings nearly as in *atropos*. Borneo. One specimen. Intermediate between *atropos* and *medusa* but apparently distinct from both (Kirby).

Teratological examples.—Undoubtedly there are numerous specimens in various collections. Two remarkable teratological examples in the "Webb coll." are interesting owing to the peculiar modification of the markings of the crippled wing so that they become more or less longitudinal. We noted these as:

1. The right pair of wings slightly contracted. The centre of the costa of the right forewing slightly excised: the coloration pale; the markings from the basal line tending to form longitudinal streaks following the nervures towards the outer margin. The right hindwing with a very straight outer margin running in line with the outer margin of the forewing; a distinct angular extension towards the anal angle, the inner black band very sharply angulated through the discoidal spot, the outer area of the wing suffused, with the black markings linear, and radiating towards margin. The left pair of wings normal.

2. The right pair of wings normal. The left forewing with a large lunular excision on the costa towards the apex. The markings from the discoidal and lower part of the basal line forming longitudinal streaks, following the direction of the nervures to the outer margin. The left hindwing with the costa cut short, at about one-fourth from the apex; the apex thus suppressed; the shortened wing, however, with perfect fringes; the normal black bands modified into radiating lines running in the direction of the nervures.

3. A moth minus the right antenna, and with an ill-developed eye on the same side. In the pupa from which it was bred the right antenna was deformed (Woodforde, *Ent.*, xxviii., p. 310).

4. A specimen with one half of the proboscis much longer than normal, the other half much shorter (see Chapman, *anteà*, p. 395, for detailed description).

Ovum.—Small in proportion to the size of the moth; light greenish or greyish-blue in colour: after the larva has hatched the empty eggshell is bluish-white (Gauckler). Proportionately small, similar to the egg of *Amorpha populi*, dull greenish or blue-grey in colour; empty eggshell transparent bluish-white (Bartel).

Egglaying.—The eggs are usually deposited singly, more rarely, however, in small batches (Gauckler). The distribution of the larvæ (scarcely more than a few in a large field) suggests that the eggs are laid at widely distant intervals, one here, one there, but not many as a rule near the same spot (Morres). Newman says (*Ent.*, ii., p. 280) that the eggs are very large* and mostly laid on the upper surface of the leaves of potato, &c. . . . . the egg-stage lasting about twelve days. Reid records (*Ent. Rec.*, i., p. 337) a ♀ that was captured when fluttering over a potato-plant in July. Gauckler says (*Ein Beitrag zur Eiablage der Schmetterlinge*, p. 5) that a ♀ he found laid 27 eggs from which he reared 16 perfect imagines.

Parthenogenesis.—Parthenogenesis is reported to have occurred in this species (Massa, *Bull. Soc. Ent. Ital.*, xx., p. 64).

Habits of larva.—The larva of this species grows very rapidly, the first four ecdyses following one another very quickly, usually within four or five days. The fifth (and last) stage is completed in about 8 to 14 days, so that the entire larval period may occupy no more than 30 days (Gauckler *in litt.*). Newman states that, at first, the young larvæ eat little and grow very slowly, but afterwards devour the leaves most voraciously, and increase in size with almost incredible rapidity (*Ent.*, ii., p. 281). The habits of the larva in its earlier stadia are practically unknown, but those of the larva in its last stadium have been described by many authors. Meinecke says (*Naturforscher*, xiii., p. 176) that the larva feeds only at night and hides itself by day, but Schröter (*op. cit.*, xx., pp. 173 *et seq.*) denies this, and states that

* Newman gives no authority for this. His statement must be compared with that of Gauckler *suprà*).

those he reared not only fed at all times of the day, but more by day, than by night. He adds that the larvæ are very sluggish, sitting with the venter firmly pressed against the stem of the foodplant, simply extending the head and neck to feed, which they will do in all possible positions. They select the finest leaves, and readily eat the tenderest stalks. A mere touch or breath will make them withdraw their heads and remain motionless, and, though they dislike wind, they enjoy the sun. He says he once observed a duel which lasted two minutes, each larva trying to get hold of the neck of the other, that being the weakest part, whilst Goeze had already asserted that, if the larvæ came across each other, they plainly hiss and mutually bite one another. Haworth remarked, in 1803 (*Lep. Brit.*), upon the skill with which the larvæ concealed themselves by day on those parts of the stems which are best covered with overshadowing leaves, and it is really remarkable how well the large full-fed larvæ hide themselves, clinging as they almost invariably do, to the underside of the stalk back downward, so that the eye might pass over scores of them without observing them, notwithstanding their size and colouring. Morres observes (*Notes on Acherontia atropos*, p. 5) that one caterpillar was found by noticing a leaf slightly in motion while all around was still, closer examination showing the disc of the caterpillar's face as it was greedily munching its mid-day meal, although the rest of the larva was quite hidden; another was discovered by noticing the haulm of a potato-plant much eaten, and then instituting a close search; a third was observed clinging to a naked stalk of the haulm in the Sphinx-like attitude, quite motionless, &c. He further observes that the yellow, green and brown of these enormous caterpillars match strikingly with the three growths of the potato-leaves themselves—the bright green of the earlier foliage, the yellower tint of the later leaf, and the diseased or decaying foliage (which the brown larva matches so exactly that the untrained eye would never detect it)—whilst the stripes of the larva amalgamate most wondrously with the lateral ribs of the potato-leaf. This is remarkable as the potato (an introduced plant) cannot have been the original foodplant of the species which is unknown in America whence comes the potato-plant. Leech also notes (*Ent.*, xxix., p. 316) that the coloration of the larva closely resembles that of its foodplant, which renders it far from a conspicuous object when at rest on a potato-stem; he notes one example which, when about to pupate, assumed a yellow coloration exactly like that of a withered leaf. Mathew writes (*op. cit.*, 1901, p. 281) that the larvæ are not difficult to find, for, by walking slowly between the rows of potatoes, one could see where the larvæ had been feeding, as the haulms, in many instances, were nearly stripped, and the larvæ were usually to be found upon the underside of one of the lower leaves; where the plants were not of luxuriant growth the larva was easy to see some distance off, and one was detected nearly a hundred yards away as it rested on a bare stem, where it looked very conspicuous in the rays of the setting sun. Thorpe says (*Ent.*, v., p. 143) that the larvæ are best found between 4 a.m. and 9 a.m., as they are, at this time, more exposed than later, *e.g.*, at mid-day. Bartel writes (*Pal. Gross-Schmett.*, ii., p. 19) that "the larvæ are best found by searching potato-fields, where the traces

of feeding and the large frass betray their presence; one larva eats so much that the plants are often stripped quite bare for a distance of some yards, and only the thickest stalks are left standing." Bartel adds that the larvæ can also be found by night with a lantern. Stephens notes, too, that the usual time for the larvæ to feed is in the evening. Aigner-Abafi says (*Illus. Zeits. für Ent.*, iv., p. 177) that, in Hungary, yellow, green, and dark brown larvæ are found at the same time on *Lycium*, that they sit motionless by day, either well into the plants or at the foot, as well as on the pendent twigs, and that they feed chiefly, but not exclusively, by night. The Sphinx attitude is, he says, mostly adopted in the daytime; he also observes that they crawl very slowly when moving for fresh food or for shelter. The larvæ are, in some years, exceedingly abundant, in others entirely absent; the years in which they have been most abundant, in Britain, are 1826, 1842, 1846, 1853, 1858, 1865, 1868, 1878, 1885, 1896 and 1900. Stephens records (*Illus. Haust.*, i., p. 117) how, in 1826, near Ham, in Essex, one gentleman obtained nearly a bushel of pupæ in the course of a few weeks from the labourers in the potato fields. Forington records 200 pupæ, in 1858, at East Stockwith, and Hobson some 150 at Selby, in the same year, whilst Whittle observes that more than 100 were taken to one lepidopterist, near Southend, in the autumn of 1899. Morres states that he obtained, in 1878, at Salisbury, no fewer than 122 larvæ from a potato field of 3 acres, while, in 1896, Brooks notes (*Ent.*, xxix., p. 336) that above 200 larvæ were sent to him from Long Sutton, in Lincolnshire, and that, in 1900, he had over 500 pupæ, from which he bred more than 150 imagines from the same place (*in litt.*). Norgate observes (*Ent. Rec.*, ix., p. 23) that he once saw, in Norfolk, a potato field, in light sandy soil, surrounded by Scotch fir-woods, in which every potato-plant was eaten and nothing but short stumps of stalks left, whilst the ground was completely covered by the footmarks and frass of the larvæ of *M. atropos* (as if a flock of pigmy sheep had been folded there till not a leaf was left). In confinement, the larvæ require plenty of air, heat and light, or they cannot be reared. (Morres suggests a large tea-chest, providing plenty of room to hold a sufficiency of potato-haulm without touching the sides of the box, as a suitable breeding-cage for a fair number of larvæ.) The larva has been repeatedly noticed as being capable of making a sound with its mouth. Scopoli, in 1763, writes (*Ent. Carn.*, p. 185): "Larva irritata stridens." This sound was also noticed by J. G. Hübner (Fuessly's *Archiv*, i., 1, p. 4) in 1781, when he wrote, "This larva draws itself together on the slightest touch, and makes a rather strong crackling sound, which I cannot describe better than by comparing it with the crackling of an electric spark." Fuessly, in an editorial note at the end of the article (*loc. cit.*, p. 6), says: "The hissing of this larva, or, as Herr Hübner better expresses it, the crackling, has also been noticed by Scopoli and Goeze; according to these entomologists, and according to my own experience, not only the black, but also the yellow and green, larvæ do this." This was later verified by Verloren (*Alg. Konst- en Letterbode*, 1847, 2, p. 147) and numerous English observers, and is described by Newman (*Ent.*, ii., p. 282) as "resembling the sound resulting from a rapidly continued series

of electric sparks," whilst Sanders writes (*Ent. Wk. Int.*, iv., p. 196): "The larva makes a crackling noise similar to that made by boys with their thumb-nails, and equally as loud . . . . sometimes it makes a very rapid succession of the same noises not unlike that produced from the winding up of a watch," and Burrows says (*Ent. Rec.*, xiii., pp. 155-156): "The larva makes, when irritated, a slight 'clicking' noise, such as one can make with one's finger-nails," whilst Parry observes (*Ent. Wk. Int.*, v., p. 29) that the larva often repeats the noise several times in quick succession. Bartel says (*Pal. Gross-Schmett.*, ii., p. 19): "The fullgrown larva gives out, when irritated, a tolerably loud and clear chirping sound, which is produced by a rubbing together of the mouth-parts." Many other authors have noticed the fact and Paris observes (*Ann. Soc. Ent. France*, iv., p. cxii) the cry of the larva as being made when the latter is excited. He describes it as softer and shriller than that made by the imago and asserts that, at each cry, a whitish mucous escapes from between the mandibles, and he concludes therefrom that the imaginal tongue is already in process of development, in the form of a gland that opens between the mandibles, although this could not be proved. Landois describes (*Ton- und Stimmap. der Insecten*, p. 59) the crackling sound made by the larva as the result of "a testy lateral jerk of the head, due probably to muscular contraction," but Clifford, in spite of the above evidence (*Ent.*, xviii., p. 302), questioned whether the larva could produce a sound, as one he had was obstinately silent, whilst he further stated that Fuessly first asserted the fact, and that Newman had confirmed it. Anderson then wrote to maintain (*loc. cit.*, p. 324) that the larva could make a noise which, he reiterated, exactly resembles the sound made by an electric spark, although he could not tell how it was caused. Poulton observes (*Ent.*, xix., p. 17) that, of several larvæ kept under observation in 1885, only one made any sound. The noise he said was evidently of a defensive character, was made when the larva was irritated, especially if handled, or tapped on the head. The sound, he considers, proceeds from tbe mandibles which are very large, and have a considerable range of movement, so that they can bite over each other. On the outer surface of each mandible there is, he says, a transverse tuberculated ridge, and when one mandible is outside the other, and is gliding over the outer surface of the latter towards its base, it is momentarily arrested by the ridge, but passes over it with a jerk, that causes sharp collision with the outer surface on the basal side of the ridge. This sudden jerk and resisting clash of the hard chitinous surface is, he believes, the cause of the sound. He further notes that the sound may be protective. Aigner-Abafi confirms (*Illus. Zeits. für Ent.*, iv., p. 356) this view, and gives a sketch of the mandibles, stating that the sound is produced by the mandibles, which are provided with notched teeth, being brought sharply together. The same explanation had many years previously been given by Capronnier. The views of Kleemann, who also stated that the sound was caused by the movement of the jaws, and others are also quoted. Pearce observes (*Ent.*, xix., p. 44) that he heard the snapping noise made by the larva of this species on two or three occasions, in 1885, and believes it to have been made by gnashing the mandibles. Morres

asserts (*Notes on Acherontia atropos*, p. 19) that the sound made by the larva is not so loud a squeak, but precisely the same sound as is made by the moth; he only once heard it, and could scarcely believe his ears on hearing it. He appears to be almost the only observer who considers the sound similar to that made by the imago, except Kleemann (Rösel's *Insecten-Belustigung*, iii., p. 12), who also asserts that the noise made is exactly like that produced by the imago, but fainter. Anderson, on the other hand, confirms Hübner's observation, and asserts (*Ent. Rec.*, vii., p. 40) that the sound emitted resembles the "click" of an electric spark, and is quite distinct from the "squeak" of the moth. Swinton notes (*E.M.M.*, xiii., p. 220) that the crepitation, peculiar to *Manduca*, has been well attested, *e.g.*, Scopoli, *Ent. Carn.*, p. 185; Meigen, *Syst. Beschr.*, ii., p. 147; Weatherhead, *Zoologist*, 1858, pp. 6212, 6282, &c; *Proc. Ent. Soc. Lond.*, iv., p. 157, &c. In spite of the observations of Capronnier, Poulton and Aigner-Abafi (*suprà*), Lambillion asserts (*Ent. Rec.*, xii., p.295) that the larval cry comes from the buccal organs of the insect and that the larva seems to open its mouth each time the cry is heard, that it is only produced by the rubbing of one organ against another, he adds, is a view that is scarcely admissible. There seems, however, no reason to doubt the conclusion of Capronnier, Poulton and Aigner-Abafi, *i.e.*, that the sound proceeds from the mandibles. When fullfed, the larvæ begin to change colour, and grow very restless, becoming semi-transparent, golden-yellow, and looking as though they had been soaked in oil (Burrows), and crawling continuously until they find a suitable place for pupation. Bowles also notes (*Ent. Rec.*, ix., p. 42) that, of a dozen larvæ of *M. atropos*, brought him in 1896, all were of the green form, turning to golden-yellow when quite fullfed. The larvæ will rarely go down into the earth in the breeding-cage in which they have been kept in confinement, for pupation, and should be placed separately in a large flower-pot filled with fresh damp earth with about 1 inch of room to spare between the surface of the soil and the top of the pot, into which, if the pot be covered, they will, as a rule, bury directly (Morres). Aigner-Abafi says (*Illus. Zeits. für Ent.*, iv., p. 178) that the larvæ only occur in one generation in Germany, and may be found from July to September, that, in southern France, there are two appearances, in July and September, whilst in the Italian Riviera, near San Remo, one finds them almost continually from July to the middle of December, and rarely even examples are found at the commencement of January. In Hungary, also, there are two generations, one in June and July, principally on potato, the other from the end of August to the end of October, *i.e.*, to the commencement of the frosts, chiefly on *Lycium*; the first brood, he says, is much the rarer, but, in some years, in September and October, the larvæ are very common, *e.g.*, 1865, 1878, 1886 and 1892, rather less so in 1897, when the first fullfed examples were taken on September 12th, but were abundant on October 3rd, and October 4th, when some larvæ were still very small, others quite ready for pupation, &c. As evidence to show how bad weather tends to kill off autumnal larvæ of this species in central Europe, Aigner-Abafi recounts how, in October, 1897, a period of cold rainy weather set in after October 4th; he states that it lasted 8 days, and caused larvæ, kept exposed on a window-sill with a plentiful supply of food, to become quite torpid, and he adds that he had to remove them indoors before they

commenced again to feed, whilst, in the fields, at the end of this period, he found many numbed, and of those he took home most perished, evidently injured by the cold. It is averred that, in some years, the larvæ are sufficiently abundant in Hungary to damage the potatoes (*Rovartini Lapok*, iii., p. 224). The following dates on which larvæ and pupæ have been found will probably prove interesting: Larvæ July-September in Upper Austria (Himsl), and half-grown larvæ in July in Roumania on potato (Caradja), a large number of larvæ in June, 1846, at Gray, in France (Paris), a larva in August, 1887, at Gibraltar (Walker), larvæ very common in October and November at Gallipoli, in 1878 (Mathew); Powell says (*in litt.*): "The larvæ are found at Hyères in October and November, but the late examples do not mature; I have never taken larvæ earlier than September, and those found in October are quite young, nor have I ever heard of anyone finding summer-feeding larvæ"; as bearing, however, on this point, Siépi says that, as a result of somewhat haphazard collecting over many years in the Marseilles district, he has obtained —in July, 2 larvæ; in August, 4 larvæ; in September, 9 larvæ; in October, 23 larvæ. Larvæ occurred throughout the winter and spring of both 1869 and 1870 in northwest Morocco (Blackmore), and in January at Tangier (Meade-Waldo), whilst at Durban, in Natal, the larvæ are fullfed in January and again in May, the species being apparently definitely double-brooded. Over a long series of years, 1887-1901, Burrows notes the earliest date of the capture of the larvæ, in Essex, as July 15th, 1893, and the latest, October 12th, 1901; whilst other records are as follows: 6 larvæ at Sudbury in the autumn of 1844, one still feeding on October 18th, 1844 (Gaze), 4 larvæ in August, 1846, at St. Just (Noye), 11 larvæ and 15 pupæ between August 1st and October 6th, 1846, at Chelmsford (Greenwood), larvæ end of July, 1846, at Beeston, one imago emerged September, 1846 (Wolley), and several larvæ in July, 1846, at Hull, imagines emerged in August (Norman), large numbers of larvæ and pupæ are recorded for 1846 (*Zool.*, 1846, pp. 1345-1654); many others in 1847 (see *Zool.*, v., pp. 1787-2076), October 2nd, 1847, at Berwick Hill (Bold), &c., also in 1850 (*Zool.*, ix., p. 3008), and in 1853 (*Zool.*, xi., p. 4072), larvæ August 19th-30th, 1856, at Wateringbury (Fremlin), larvæ August 20th-26th, 1856, at Hither Green (Morris), larvæ August 25th, 1856, near Reigate (Wollaston), 18 larvæ, full-grown, week ending August 31st, 1856, at Fordwich (Cox), 50 full-grown larvæ in 1857 before September 19th, at Plymouth (Ryder), larva July 19th, 1858, at Harrow (Walker), 6 larvæ July 20th-August 2nd, 1858, at Twickenham (Boscher), 5 fullgrown larvæ on July 24th, 1858, and days just preceding, at Brighthampton (Stone), July 23rd, 1858, larva at Uckfield (Hay), July 29th, 1858, at Middleton (Woods), 60-70 larvæ and pupæ throughout August and September, 1858, at Newark (Gascoyne), 92 larvæ and pupæ in the autumn of 1858, at Worcester, 50 perfect imagines and 13 cripples bred therefrom, above 200 larvæ and pupæ altogether collected by the Worcester lepidopterists (Edmunds), several larvæ in August, 1858, at Cheltenham (Alington), larvæ August 2nd, 1858, at Newnham (Bingham), August 3rd, 4th, 5th, 1858, at Exeter (Hellins), 20 larvæ up to August 5th, 1858, at Leckhampton (Trye), August 6th, 1858, at Darlington (Eales), others up to August 26th (Orde), August 8th, 1858, fullfed, went down same day, at Rotherham (Rodgers), August 9th, 1858,

at Emsworth (Buckler), fullfed August 9th, 1858, at Deal (Harding), larvæ middle of August, 1858, at Southampton (Oakley), 3 fullgrown larvæ buried August 16th, 1858, at Haydon Bridge (Morison), 7 larvæ up to August 21st, 1858, at Guisborough (Jeffrey), 6 larvæ at Camberwell up to August 22nd, 1858 (Keen), several larvæ before August 24th, 1858, at Bow Brickhill (Burney), larvæ common in July, 1859, at Leckhampton, some 50 or 60 pupæ also taken in August (Trye), many larvæ almost fullfed before July 18th, 1859, at Brighthampton (Stone), larvæ abundant in August, 1859, at Fordingbridge (Neave), fullfed larvæ near Exeter first week in August, 1859 (Potter), some 40 larvæ and pupæ at Newnham in August, 1859 (Bingham), many larvæ and pupæ during September and October, 1859, near Leigh (Daniels), first week in August, 1861, at Wateringbury (Fremlin), larvæ July 20th, 22nd, 25th, 28th, 1865, at Minehead, 16 pupæ resulted, from which 10 imagines, 6 ♂ s and 4 ♀ s, emerged during October and November, 5 pupæ died, and 1 was alive in January, 1866 (Bonnor), larvæ not scarce at Eltham in July, 1865 (A. H. Jones), many larvæ in the Hull district in July and first week of August, 1865 (Wright), fullfed larvæ at the end of July, 1865, others right through August, at Lytham (Gregson), 33 larvæ and pupæ between July and September, 1865, the larvæ pupated in August and September at Winchester, only about one-sixth of the pupæ had produced imagines during October (Johns), 2 fullfed larvæ on July 29th, 1865, at Wetherby (Forby), August 19th, 1865, at Devonport (Last), pupæ on August 22nd, 1865, near Devonport (Hayward), 10 larvæ in the week ended August 22nd, 1865, at Alloa (Borthwick), a pupa, September 10th, 1865, at Leominster, produced an imago on October 22nd (Hutchinson), several pupæ September 16th, 1865, at Portsdown and near Landport (Moncreaff), August 10th-21st, 1867, 30 larvæ at Lewes (Jenner), a dozen larvæ in the week ended August 20th, 1867, at Wolverton (Barlow), 120 larvæ at Blackpool in August, 1868, and 24 in August, 1869 (Thorpe), larvæ, August, 1869, at Durham (Raine), September 3rd, 1869, at Guestling (Bloomfield), August 17th, 1870, near Painswick (Watkins), larva about August 5th, 1871, buried August 21st, pupa forced and imago emerged on October 23rd, at Lyndhurst (Lockyer), many larvæ and pupæ in August, 1877, at Norwich, from one an imago emerged September 30th, 1877 (Laddiman), a dozen larvæ in August and September, 1877, at Chichester, pupated, one imago emerged November, 1877, others on June 18th ♂, 23rd ♂, 24th ♀, 25th ♂, 28th ♂, 29th ♂, and the last, ♂, July 5th, 1878 (Anderson), August 6th, 1877, a larva at Birmingham (Enock), many pupæ in August, 1877, at Harwich (Kerry), July 29th, 1878, larvæ fullfed at Sawtry St. Judith (Bower), a dozen larvæ on July 30th, 1878, and following days at Burton-on-Trent (Baker), August 16th, 1878, at Bedford (Greenwell-Lax), September 4th, 1878, at Reading (Butler), September 11th, 1878, at Morpeth (Finlay), 26 pupæ and one larva in October, 1878, round Liverpool (West), September 10th, 1880, at Reading (Holland), fullgrown larva September, 1884, at Frome (St. John), large numbers of larvæ in August, 1885, at St. Ives (Norris), several larvæ August, 1885, at Harwich (Kerry), three larvæ in August, 1885, at Reading (Butler), larvæ at Castle Cary, August 10th, 16th, 22nd, 23rd, 24th, 1885 (Macmillan), October, 1885, at Surbiton (Goss), August 1st, 1886, larva at Woodbridge

(Freeman), September 17th, 1886, at Henley (Holland), larvæ fullfed end of July, 1887, at Sudbury (Ransom), larva August 9th, 1887, at Brentwood (Burrows), end of August, 1887, in the Scilly Isles (Crewe), several larvæ in early August, 1889, at Alford (Mason), August 6th, 1889, two fullfed larvæ at Pevensey Sluice (Howe), August 26th, 1889, one fullfed at Caversham, also others on August 31st, September 15th, 16th, 21st, 1889, at Reading (Holland), fullfed larva September 7th, 1889, from Manley, near Delamere (Newstead), fullfed larva on August 5th, 1892, at Chichester (Anderson), 2 larvæ August 15th, 1892, at Folkestone (Byrne), larvæ July 9th, 1893, at Corfe Castle, 2 pupated and produced imagines on October 10th and 11th (Bankes), larvæ July 12th, 1893, at Slough, one died, imagines emerged September 20th and 28th (Williamson), larva July 12th, 1893, at Tenby (Jefferys), larvæ July 12th, 1893, at Chichester, pupated at once (Anderson), larvæ July 15th, 1893, at Rainham (Burrows), larvæ pupated August 2nd and 10th, 1893, at Chilwell (Pearson), August 7th, 1893, at Stanton Drew (Greer), August 9th-17th, 1894, at Rainham (Burrows), pupa October 18th, 1894, at Royston (Wilson), 2 larvæ August 13th, 1895, at Wellington (Milton), several larvæ August-October, 1895, at Market Drayton (Woodforde), 6 larvæ between September 1st-23rd, 1895, at Rainham (Burrows), a fullfed larva about September 1st, 1895, at Clevedon (Mason), 15 larvæ in September, 1895, at Market Rasen (Lewington), fullgrown larvæ from July 18th onwards till August 27th, 1896, at Kings Lynn (Atmore), July 20th-25th, 1896, at Rainham (Burrows), many larvæ July 22nd-September 1st, 1896, at Chichester (Anderson), many larvæ in August, 1896, at Starcross, one went down on August 20th, and an imago emerged therefrom on October 30th (Jäger), larvæ at Clevedon in August, 1896, one imago emerged end of September (Jefferys), two larvæ at Sandown in August, 1896 (Prout), August 1st, 1896, several, at Ringwood (Fowler), 2 larvæ August 3rd, 1896, at Rivenhall, pupated, one imago emerged October 23rd, the other on October 29th (Cattle), a larva on August 4th, 1896, at Elsenham (Cornell), August 7th, 1896, larva at Seaford (Hill), August 8th, 1896, at Panton (Raynor), August 10th, 1896, larvæ at Lewes (Leech), August 13th, 1896, fullgrown larvæ at Whitchurch (Thornewill), pupæ August 15th, 1896, at East Mersea (Cole), larva August 17th, 1896, at Hawkhurst (Adams), fullfed larva August 18th, 1896, near Copmanthorpe (Hewett), larvæ August, 1896, at Cairnryan (Bruce), larvæ August, 1896, at Kingston (Mitchell), September, 1896, at Chelmsford (Miller), larvæ September, 1896, at Oxton (Studd), many larvæ and pupæ in early September, 1896, at Fleetwood (Oldham), September 3rd, 1896, at Crosby (Jones), larvæ September 4th, 1896, at Cluden, near Dumfries (Service), fullgrown larva, September 7th, 1896, near Chester (Denson), September 18th, 1896, at Waldringfield (James), unusually abundant, above 150 between September 19th-30th, 1896, and 50 more by October 10th, in the Long Sutton district (Brooks), a larva in July, 1897, at Sudbury (Ransom), larva September 3rd, 1897, at Crosby (Freeman), larvæ at Dover in the autumn of 1898 (Stockwell), pupa August 24th, 1898, at Chichester (Anderson), larva on November 8th, 1898, in Guernsey, went down November 10th, fullfed larva July 15th, 1899, at Alderney

(Luff), August and September, 1899, 5 larvæ at Castle Bellingham (Thornhill), fullfed larva early in August, 1899, at Ewell (Hills), larva early August, 1899, at Bridgwater (Waller), larvæ near Worcester, August 7th-10th, 1899 (Rea), August 22nd, 1899, fullfed larva at Chilton (Ransom), fullfed larva August 24th, 1899, at Broadstairs (Russell), larva end of August, 1899, at Whitchurch (Thornewill), 2 larvæ August 30th, September 2nd, 1899, at Wakefield (Parkin), mid-September, 1899, several pupæ dug near Emsworth (Christy), September 7th-October 25th, 1899, pupæ at Oxton (Studd), September, 1899, several larvæ at Carlisle (Routledge), 4 larvæ in a garden, September 11th-12th, 1899, at Thornton Heath (Lindemann), larva September 22nd, 1899, at Norwich, 11 other larvæ July 24th, 1900, at Norwich, all had gone to earth by August 3rd (Laddiman), 26 larvæ in July and early August, 1900, at Stowmarket, pupated in flower-pots, in which the pupæ were successfully forced (Baker), fullfed larva went down July 27th, 1900, at South Leverton (Thornley), one larva fullfed July 27th, 1900, at Twyford, one at Reading, July 31st (Butler), larvæ July 28th, 1900, and following days at Chichester (Anderson), 8 fullfed larvæ last week in July, 1900, near Haddenham (Barton), several at end of July and in early August, 1900, at Sudbury (Ransom), larvæ and pupa at Lendalfoot, August, 1900 (Wilson), August 2nd-8th, 1900, at Emsworth (Christy), larvæ from August 2nd-October 12th, 1900, pupæ from October 13th-October 20th, 1900, at Mucking (Burrows), one larva August 4th, 1900, at Writtle, others on August 4th, 6th, 1900, at Woodham Mortimer (Raynor), larvæ August 4th, 1900, and following days at Middleton (King), several larvæ from August 5th-15th, 1900, near Salisbury (Cowl), larvæ August 6th, 1900, and following days at Farnborough (Alderson), August 8th-10th, 1900, larvæ at Hampstead (Hopson), August 13th, 1900, at Ramsey (Clarke), August 14th-October 12th, 1900, at Portland (Hyde), a fullfed larva on August 16th, 1900, at Great Cotes (Quirk), a larva at Boston Spa, August 19th, 1900 (Prince), about 30 larvæ and pupæ between August 25th, 1900, and November 3rd, 1900, in the neighbourhood of Natland and Foulshaw (Moss), larva on August 26th, 1900, at Netherton (Fawcett), larvæ August 29th, 1900, at Fakenham (Woolhouse), larvæ August 29th, 1900, at Ulverston (Petty), larva August 31st, 1900, from Lower Tooting (Sparke), above 500 larvæ and pupæ from the Long Sutton district, August and September, 1900 (Brooks), larvæ September 1st and 8th, 1900, at Smafield, September 5th at Lilburn Tower, September 18th, one near Ancroft, and one from Holy Island, September 20th at Wooler, September 22nd from Plea Piece, and in October one at Brock Mill, near Beal (Bolam), larva September 10th, 1900, others first week in October at Alderley Edge (Oldham), September 14th, 1900, in south Devon (Mera), September 18th-19th, 1900, pupæ at Oxton (Studd), pupa September 20th, 1900, near Dumfries (Service), 20 larvæ and nearly 200 pupæ at Market Drayton in the autumn of 1900 (Woodforde), 19 larvæ and 2 pupæ at Carnforth just previous to September 22nd, 1900 (Murray), October 19th, 1900, at Bexley, went down October 30th (Newman), larvæ abundant in July, 1901, at Doncaster (Corbett), larvæ July 28th-September 9th, 1901, at Fakenham (Woolhouse), larva on August 5th, 1901, at Shepperton-on-Thames (Russell), larva August 6th, 1901, at Warmfield (Townsend),

earliest larva of the year at Chichester on August 7th, 1901 (Anderson), August 7th (fullgrown) to September 28th, 1901, at Sudbury (Ransom), larvæ abundant at Ringwood, August 8th-October 5th, 1901 (Fowler), larvæ August 14th, August 15th, several nearly fullgrown, August 16th six, August 17th five, and 20 from August 19th-September 10th, 1901, at Dovercourt (Mathew), larvæ August 16th, 22nd, 28th, 1901 (this last pupated on September 2nd), September 14th (this pupated on the 16th), October 4th, a pupa at Elstow, all these died (Pestell), August 17th, 1901, larva at Hull (Walsh), August 20th-September 11th, 1901, several larvæ and pupæ in the Norwich district (Moss), August 20th, 1901, two larvæ at Hayling Island (May), larvæ August 24th, 1901, at Sherburn, September 3rd, 1901, at Brompton, September 5th, 1901, at Ayton (Lownsboro), larva August 28th, 1901, at Ilford (Adams), September 14th, at Chathill (Allhusen), 2 larvæ on September 21st, 1901, and one pupa on November 3rd, at Kildale (Sachse). It is remarkable that there is not a single record for Britain earlier than July, although, occasionally, full-fed examples are recorded as having been captured in early July. We place no credence in Packman's offhand assertion (South, *Ent.*, xix., p. 147) that almost fullfed examples occur in Kent in June. We have lived in Kent for nearly half a century, and never heard of or saw larvæ earlier than July.

Larva.—*Final instar.*—A small larva at full stretch measured only 3ins. in length; at rest the head is slightly retracted. Head: A tall, slightly-rounded trapezoid, somewhat bulged at the sides; the surface, although shiny, is very rugose, and the hairs are very fine and small (I fail to trace any on the face); in colour the head is of a vivid apple-green with a broad black band up the sides from the ocelli to near the crown; the clypeal and median sutures are not deep, the crown only very slightly notched; the mouth-parts and antennæ black with white at joints. True legs: Black with comparatively large white areas surrounding the bases of hairs. Body: The body is stout and plump, tapering but little for a Sphingid larva. Thoracic segments stout and compressed, having a swollen and hooded appearance; they are of a clearer and more pellucid green than the rest of the body; the prothoracic scutellum present but not markedly prominent; the meso- and metathorax appear to be subdivided into five subsegments. The 1st abdominal segment is considerably shorter than the following segments, and I can only count six subsegments on it, but the abdominal segments 2 to 7 have eight subdivisions. The spiracles are black, bordered with white; the hairs and mammillæ (shagreen-tubercles) are all but atrophied, but the coloured areas surrounding the hair-bases are still strongly in evidence on the dorsal area. The caudal horn is stiff, its roughness due to the large and thorn-like mammillæ at bases of hairs; these mammillæ are white, the horn itself yellow, the tip black. The oblique stripes are strongly pigmented, yellow beneath and purple-blue above. The shagreen-spots (pigmented areas surrounding hair-bases) are dark purple, shading off into blue and green at the edges (Bacot. August 21st, 1900.) Two other examples (preserved by inflation and well done) have dimensions as follows: (1) Length 83mm., girth 12mm., size of head 8·5mm. in height and nearly 8mm. in width, length of head and thorax 22·5mm. (2) Length 110mm., girth

13·5mm., size of head 6mm. in height, 5·5mm. in width, length ot head and thorax 25mm. The length of the caudal horn differs scarcely at all in the two larvæ, and is 7mm. It will be seen that the smaller (and presumably younger) larva has the larger head; the larvæ also differ in that the head of the larger one is markedly notched at the crown, whilst that of the other is not notched at all. The head is a rounded trapezoid in outline, and appears much taller and narrower than it really is, owing to the broad black stripe down either side. Its colour is bright yellow, the surface corrugated or convoluted rather coarsely, although the surface of these convolutions is quite smooth and polished-looking; in addition to the broad black bands down the sides of the head, a narrower black streak runs across from the bases of antennæ to the mouth-parts, which are, for the most part, black, although the skin at the articulation shows white; the bases of the antennæ are pale, the two upper joints black. The ocelli are clear and glassy-looking, with a white area beneath (but this is probably not the colour when the larva is alive). The body is of fairly even thickness, tapering quite suddenly to the head. The prothoracic scutellar plate is structurally apparent, but not differentiated as regards colour; the thoracic segments are very distinctly different from the abdominal, both in colour and structure; the subsegmental divisions being larger on the former, and not so apparent owing to the complete absence of the coloured areas surrounding the bases of the shagreen-hairs, which are so strongly marked a feature on the dorsal area of the abdominal segments. The spiracles are very distinct, black- or dark-crimson-centred surrounded by white. The true legs are black, as are also the strong fringes of hooks on the prolegs. The subsegments, as shown by the purple dots at the base of the shagreen-hairs on the dorsal area, are six on the 1st abdominal, and eight on the following segments, 2 to 6, the 7th abdominal only shows five rows, although there are quite eight subdivisions. There is doubtfully a seventh structural subdivision in front of the marked ones on the 1st abdominal, but this is not very clear in the larger larva, and does not show up at all on the smaller one; the 1st abdominal segment is shorter than the others (Bacot, June 27th, 1903). Chaumette describes (*Zoologist*, ix., p. 3242) the green and the dark forms very fairly; Newman also describes the full-grown green form of larva (*Entom.*, ii., p. 281), and gives (*loc. cit.*, p. 282) a short diagnosis of the dark form, which, he says, was also described by Fuessly, three times figured by Hübner and three times described in the *Zoologist* (pp. 1658, 6282, 6788).

COMPARISON OF THE LARVÆ OF MANDUCA ATROPOS AND SPHINX LIGUSTRI.—*Final instar:* The larva bears the closest resemblance to that of *Sphinx ligustri*. The shape of the head is exactly similar, with the same arrangement of the black marginal line relatively to the face, except that the black borders very nearly meet at the apex of the head in *S. ligustri* while they do not come so near to complete fusion in *M. atropos*. In the larvæ of both species the black bands attenuate considerably towards the apex of the head. The most striking resemblance, however, is afforded by the appearance and position, during the resting attitude, of the thoracic segments, which, in both species, are swollen and transparent-looking, and without a trace of marking. All the larval markings end abruptly at the anterior edge of the first abdominal segment, except the border of the anterior stripe,

which just crosses the intersegmental furrow in both species. [The resting attitude of both is also exactly similar, the head being retracted and the dorsal surface of the swollen thoracic segments curved into a quarter of a circle, as seen in profile. This is seen in the Sphinx attitude of rest, and in other positions also.] The difference between the ground colour of the thoracic segments and that of the other segments is very obvious in both cases. The difference is, perhaps, best described by saying that the former are yellower and paler, and especially, that the colour possesses a peculiar transparency which is absent from the rest of the body. The thoracic segments are, however, less bright and yellow than the ground colour in the region of the oblique stripes. [In a figure of the brown variety of *M. atropos*, painted by Mrs. Owen Wilson and sent to me by Professor R. Meldola, the ground colour of the thoracic segments is pink while that of the other segments is brown, and the contrast is therefore much greater than in the common variety. Mr. Stainton, in his *Manual*, describes the anterior segments of this variety as whitish, and the rest of the body as brownish-olive. I expect that this is more correct than the impression conveyed by the figure, although the specimen which Mrs. Wilson has painted may have been an unusual variety.*] The black thoracic spiracle of *M. atropos* resembles the ochreous anterior spiracle of *S. ligustri* and differs from that of *Smerinthus ocellatus*, &c., in being unconcealed when the larva is at rest in the Sphinx attitude. The relations of the oblique stripes and borders with those of *Sphinx ligustri* are extremely interesting. [In Stainton's *Manual*, the larva of *M. atropos* is described "with 7 oblique lateral violet stripes" and that of *S. ligustri* "with 7 oblique lateral white streaks bordered above with lilac." Certainly this correlation of the markings of the two larvæ seems sufficiently obvious, and is the one which is also given in other descriptive works. Recent investigations, however, have shown the actual relations existing between the oblique stripes and their coloured borders (by a comparison of the ontogenies of *Smerinthus* and *Sphinx* larvæ).] A careful examination of the position of the violet bands of the larva of *M. atropos* has resulted in the proof that these markings do not correspond with the stripes of *S. ligustri*, but with the coloured borders only—the latter markings, in fact, have persisted, while the oblique stripes have become inconspicuous. This correspondence is at once seen on comparing the relative positions of the caudal horn and the spiracles with the oblique markings of *M. atropos* and *S. ligustri* respectively. [The fact is recognised by Weismann, on p. 322 of the English translation of his work, where he speaks of the blue edges of the stripes of *M. atropos*, and compares them with those of *S. ligustri*.] The stripes are also present in *M. atropos*, but, being only of a lighter yellow than the rest of the ground colour, they are easily passed over. They are narrow in the lower half of their length, becoming broad above, so that they occupy very nearly the whole interval between the coloured borders in the dorsal region. This broadening takes place as each stripe crosses the furrow which separates the two segments in which its course lies. In *S. ligustri* the ground colour is much brighter in

* Chaumette describes (*Zoologist*, ix., p. 3242) the dark form as having "the thoracic segments of a pinkish-white colour . . . and the abdominal segments yellowish-brown." McLaren also notes (*op. cit.*, p. 6788) the dark variety as having "the thoracic segments white inclining to pink, the abdominal segments olive-brown." The pinkish tint is, we believe, not at all unusual.

the region of the oblique stripes and borders than elsewhere. In *M. atropos* this is probably also the case, but the brightened ground colour cannot, of course, be distinguished from the true oblique stripes (which are also brightened ground colour). Hence what is described above as a broadening of the oblique stripes may in reality be due to their fusion with another of the elements of larval colour. The brightness of the ground colour in the region of the oblique markings, due in part to stripes and in part to the ground colour itself, produces an effect which is very like that of *S. ligustri*. Below this region the ground colour becomes much darker and greener in both larvæ and, in both, the darkened colour spreads upwards in front of the borders for the lower half of their length. In *M. atropos*, a fine white line runs along the posterior margin of the inferior anterior half of each coloured border, but it seems unlikely that this represents the true stripe. The borders of *M. atropos* are violet for the chief part of their course, shading into blue anteriorly and inferiorly, and also changing abruptly into the same colour above, at the furrow which divides the two segments over which each border extends. The upward blue continuation of the border meets its fellow of the opposite side in a distinct V, of which the apex lies close to the hinder limit of the posterior of the two segments, traversed by the border. This backward prolongation of the coloured border (as such) does not take place in *S. ligustri*, but the lilac tint ceases abruptly at the furrow corresponding with that which only divides the border of *M. atropos* into two rather differently coloured halves. Nevertheless, careful examination will show that the borders of *S. ligustri* are carried back and form a series of Vs, but only as darkened ground colour, and with the loss of all distinctness. Hence each segment, from the 1st to the 7th abdominal (both inclusive), is crossed by parts of two oblique borders, of which both the upper and lower parts are very conspicuous in *M. atropos* while the upper in *S. ligustri* can only be detected after careful examination. This is also true of the stripes themselves in *S. ligustri*, while the stripe is altogether inconspicuous in *M. atropos*. The 8th abdominal segment is only crossed by the upper part of one stripe (the last) and its border, and here, also, the same contrast holds good in the two larvæ. In *M. atropos*, however, the border does not become blue, but remains of the same purple as its anterior inferior continuation. This border also becomes much narrower upon the 8th abdominal segment after crossing the furrow which separates it from the 7th segment. The larva of *M. atropos* is peculiar as compared with that of *S. ligustri* in the persistence of the "eighth stripe" in the last stage; but this latter larva possesses this feature in earlier stages, and it can even be detected immediately after the last ecdysis. In *M. atropos*, the "eighth stripe" is conspicuously represented by the bright blue border which is present upon the 1st abdominal segment, and ends abruptly at its anterior margin, thus occupying an entirely normal position. On the other hand, this is the only instance, as far as I am aware, of the "eighth stripe" gaining a coloured border, the exception being doubtless explained by the fact that this stripe consists of an upper part only (upon the 1st abdominal segment, and never extending downwards upon the 3rd thoracic segment), and such upper parts possess coloured borders in the case of *M. atropos* alone. The shagreen-dots form a very remarkable addition to the markings of the adult over the dorsal surface of the abdominal

segments (1st to 8th, both inclusive). Over an area rigidly limited by the inferior edge of the lower part of an oblique border in each segment, the shagreen-dots form the centres of relatively large circular patches of purple. These patches are larger upon the borders than elsewhere, and are especially large upon the superior posterior part of each border. The patches are especially small and scarce posterior to the upper part of the sixth border on the 7th abdominal segment, while upon the 8th abdominal segment there are only a very few faint patches, all of which are placed on the upper part of the seventh border, which traverses this segment. The purple patches have evidently spread from the bases of the dots, which are still visible in the centre of each as a small light spot (which, however, is not raised above the general surface of the larva). These dots have entirely lost the hairs in this last stage, but their former presence is probably indicated by a minute central scar-like point. The patches are also seen to be connected with dots because of their arrangement upon the eight annuli, into which each abdominal segment is divided (except the first, which is only divided into six or seven annuli). The occurrence of the dots upon the coloured borders is quite exceptional, but then, in this larva, the former become the centres of patches of the same colour as the latter, although it is noteworthy that the patches are always purple, while the upper parts of the stripes become blue. It may be that the patches point to the origin of the borders upon which they persist, but, if so, such a development of this marking is most unusual, for, in other forms, the borders arise—first by the absence of dots, secondly by the darkening of the ground colour, and finally by its replacement by a different tint. On the other parts of the larva, the shagreen-dots are more normal when they are present. Thus, upon the underside, there are extremely minute hairs borne by exceedingly small traces of dots, exactly as in the larva of *S. ligustri* in the last stage. Again, the caudal horn is well known to be rough, and this condition is caused by the persistence of true shagreen-dots upon it, many of which bear simple hairs. Comparing the larva with that of *S. ligustri* in the same stage, *M. atropos* exhibits phyletically older features in the persistence of normal shagreen-dots upon the horn, and of (much modified) dots upon the dorsal surface, and in the persistence of the "eighth stripe" (border). On the other hand, it is phyletically younger in the extreme development of the coloured borders, and, probably, in the fading away of the oblique stripes (Poulton, *Trans. Ent. Soc. London*, 1886, pp. 143-148).

DEVELOPMENT OF LARVAL MARKINGS.—*First instar:* Light yellow-green, with a long straight black horn, half as long as the larva itself. *Second instar*:* The striped pattern of the later stages becomes visible, the oblique stripes whitish. *Third instar:* Yellow or yellow-green with blue markings; the long horn now yellow at base. *Fourth instar:* Darker yellow, with darker oblique stripes; the head yellow-green bordered with black; the horn yellow, roughly granulated, somewhat curved downwards; the spiracles black. *Fifth instar:* This

* Mathew notes (*Entom.*, xxxi., p. 116) that, on November 10th, 1897, at Marmarice, on the coast of Syria, a sharp frost having occurred the previous night, he found a fullgrown larva of *M. atropos* and also a small one, only a few days old, the latter bright green with pale greenish-yellow stripes and a long slender and almost straight horn.

is the last instar, in it the larva assumes its well-known colour and markings (Gauckler, *in litt.).*

Variation of larva.—A century ago Goeze described and figured (*Naturf.*, xviii., pp. 195 *et seq.*, pl. iv., fig. 25) a variety of the larva of this species of a dirty light grey colour tinged with yellow dorsally, darker red-brown ventrally and on the head, whilst Schröter describes (*loc. cit.*, xxi., pp. 173 *et seq.*) several distinct varieties of it. Capieux attempted (*Naturf.*, xxiv., p. 97) to establish a connection between the varieties of this species and the different foodplants, based on the fact that he found 3 black-brown larvæ on *Lycium* which he states refused to eat potato. Borkhausen dissents (*Rhein. Mag.*, p. 324) from this, points out that Schröter's black-brown larvæ were found on the ordinary food, and adds that Goeze's striking variety of the larva *(suprà)* also shows how variable the species is in this stage. Stainton notes two forms of the larva of *M. atropos:* (1) Lemon-yellow, towards the head and lower part of the sides green, with 7 oblique, lateral violet stripes; horn yellowish. (2) Brownish-olive, with the lateral stripes darker; the anterior segments whitish. Authors frequently speak of the larva as dimorphic, and Bartel (*Pal. Gross-Schmett.*, ii., p. 18), after describing the yellowish-green form, writes: "More rarely there is a darker form of the larva which corresponds with the dark larval forms of *Deilephila elpenor* and *D. porcellus.* It is brown-grey or olive-brown and covered with innumerable white granulated dots arranged in rows. . . . . This dark form does not occur in young larvæ, but only in the later stages. After the last moult it becomes light green, to return some hours later to the original olive-brown colour." Newman also refers (*Ent.*, v., p. 102) to two forms, and describes the dark form *(Ent.*, ii., pp. 281-282), although Edmunds (and others) had already described it very well (*Ent. Wk. Int.*, v., p. 17). Bellier de la Chavignerie notes (*Ann. Soc. Ent. France*, (2), iv., pp. cx-cxi) that the larvæ are usually yellow or green, ornamented with blue or violet chevrons, which are clearly marked on the ground colour, but Marchand had found at Chartres, an aberration, which was of a very dark grey-brown colour, spotted with white, the chevrons of the same colour, the thoracic segments white marbled with black. Boisduval, he says, described a somewhat similar form, and Engramelle figured one, whilst others were found in September, 1846, in a potato-field near Paris by Lorquin, and others again were taken by Abicot at Gien. Guenée also observed that this form had been often described and that Hübner had figured it. Powell notes (*in litt.*) that it occurs at Hyères in the proportion of about 33 per cent., and that the largest specimen yet captured measured 150mm. Buckler gives *(Larvae,* &c., ii., pl. xxi., figs. 1-1*a*) two excellent figures of this larva:

1. Of a lovely apple-green, the thorax uuicolorous, the abdomen with the 8 characteristic oblique yellow stripes, edged above with purple and violet, and with the dorsum of the abdominal segments 1-8 with 8 rows of tiuy black shagreen-spots in no case extending ventrad of the coloured borders of the oblique stripes. The caudal horn of the ground colour; the anal flap with a yellow border.

2. The ground colour brownish-drab; the thorax whitish-drab, with a double blackish median line and broken black subdorsal; the oblique stripes black and uuited with the subdorsal lines into a rough reticulated pattern over the dorsum of the abdomen; the dorsal area above the oblique stripes of abdominal segments 1-8 red-brown; the abdominal segments 1-9 each with 8 rows of white shagreen-spots extending down to (and on) the prolegs; the caudal horn of the ground colour; the brown anal flap edged with drab.

Strangely enough, Leigh notes (*Ent.*, xxxiv., p. 48) that, at Durban, in Natal, the larvæ are almost all of the brilliant yellow form, but the larva is, at least in Europe, really more or less polymorphic, and the ground colour extends in various individuals from bright yellow to black [larvæ of this latter hue having been found (*teste* Rambur) several times near Cadiz], and the greatest variation exists in the markings of the different forms. Of intermediate forms, too, there are many examples, but Morres, who has had great numbers of larvæ, thinks that those obtained in Britain fall roughly into three distinct types, which he describes (*Notes on Acherontia atropos*, p. 2) as:

1. Of a rich golden-yellow,* inclining to green on the underparts, with seven diagonal stripes of a purplish-blue towards the base, but ending in a clear pale blue at the apex on the top of the back; the body, above the stripes, spotted more or less thickly with well-defined black spots; the thoracic segments of a somewhat clearer yellow with no spots or stripes, the facial disc of the larva bordered by two well-defined black lines.

2. Of an apple-green* colour (more like the colour of a larva of *Sphinx ligustri*); in many instances the facial disc has no black stripes at all; but the lateral stripes and spots somewhat similar to the first.

3. Of a dark umber-brown with cream-coloured stripes edged with a still darker brown; the thoracic segments of the same creamy colour as the stripes; the facial disc also being the same though striated on the surface with delicate dark interlacing brown lines.

Aigner-Abafi also writes (*Illus. Zeits. für Ent.*, iv., p. 177) that there are three forms of the larva—(1) Citron-yellow, with blue oblique stripes. (2) Green with similar stripes. (3) Dark brown-grey with white "Halszeichnung."† The last-named form, he adds, is always rare in Germany, and usually found on *Lycium*, whilst those found on potato are, as a rule, green or yellow. In Hungary, he says the three forms may be often found at the same time on *Lycium;* in Italy, at San Remo, the brown-grey larvæ are found on *Vitex agnus-castus*, whilst those on *Nicotiana glauca* are green (*Ent. Zeits. Guben*, 1897, p. 48). Aigner-Abafi also quotes Wilde (*Beschreibung der Raupen*, 1861, p. 86) as stating that, occasionally, larvæ are found almost entirely blue, and greenish-grey. As before noted, Morres says: "The colours of the different forms of this larva match strikingly with the various growths of the leaves of the potato—the bright green of the earlier foliage, the yellower tint of the later leaf, while the brown larva matches so exactly with the diseased or decaying foliage, that the untrained eye would never detect it, though possibly directly resting upon it; the stripes of the larva also amalgamate most wondrously with the lateral ribs in the potato-leaf, carrying out the delusion." Rambur connects the black Spanish form of the larva, mentioned above, with *Solanum sodomaeum*. Of other forms, we note that Bankes describes the capture of several larvæ, in 1893, one of which was brown and similar to Buckler's fig. 1*a*, but differing from it in that the front segments showed a delicate pink in place of the white, whilst the body was entirely brown, of various

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* Burrows considers the green and yellow forms to be merely younger and older forms of the same type of larva in its last instar, the green being the younger.

† Aigner-Abafi writes (*Ill. Zeits. für Ent.*, iv., p. 177): "The last form is somewhat rare; when young almost entirely black, then usually till the third moult green, but, immediately after the last moult, light green, becoming dark brown again a few hours afterwards."

shades, with no trace of red in it, and the horn ivory-coloured instead of brown. This must have been similar to that referred to by Poulton (*Trans. Ent. Soc. London*, 1886, p. 144) which had the ground colour of the thoracic segments pink, whilst that of the abdominal segments was brown. Inchbald says that, of 12 larvæ taken at Hornsea, in 1889, 7 were of a brownish-olive colour, with the anterior segments white, the white being well-defined and conspicuous. Balding records a form of larva with the thoracic segments pure white, with a broad dorsal marking of deep black coming down on either side like a double saddle; the remaining segments without the oblique markings on the sides, but with a broad chain of diamond-shaped lines and purple tracery down the back. Anderson notes that several larvæ, that he had in 1895, were of the dusky variety, which, instead of being of a beautiful apple-green tint with violet and yellow streaks, is of a dingy brown hue with a latticed pattern of dull blackish-purple on the sides and back, and a sprinkling of dirty white spots, the anterior segments being white with two stripes broken up into spots a little darker than the general colour of the body; both type and variety, he says, have a similar whitish warty caudal appendage. Sharp notes that, in 1896, when the larvæ were abundant at Cambridge, three well-marked varieties (not including the usual dark form) came under his observation:

1. The usual greenish-yellow form with moderately distinct violet-purple oblique stripes.
2. A pure green variety, with the stripes very faint, reminding one at first sight of the larva of *Sphinx ligustri*.
3. Yellow, with the oblique stripes very extensive, definite and deep-coloured.*

It appears not to have been generally recognised tbat the dark forms of the larva of *M. atropos*, not only differ entirely from the yellow and green forms in colour, but that the markings are also quite different. The ground colour of the thoracic segments is usually paler than that of the abdominal segments in the darker forms, and thus far they agree with the green and yellow varieties. Poulton, however, deals with this matter at length (*Trans. Ent. Soc. London*, 1886, pp. 149-151), basing his remarks on two dark examples, of which he says: "The ground colour of the thoracic segments is light brownish or of a dirty white, and resembles the other (normal yellow) variety in being much lighter than that of the rest of the larva, but it is entirely different in the possession of distinct and very dark markings. There is a broad median dorsal band of a very dark brown colour, which

* Sharp notes (*Ent.*, xxix., p. 284): "This individual exhibited a remarkable peculiarity, inasmuch as, on the 2nd abdominal proleg of the left side, there was no trace whatever of any of the clasping hooks; the leg seemed, in other respects, quite normal, and all the other legs had their full complement of hooks, these structures being in this species numerous and large. This specimen had received some injury near the anus, and was attacked with diarrhœa and died, so that I had no opportunity of ascertaining whether there might be a repair of the deficiency at the last moult, which possibly (but not certainly) had not taken place in this individual. Whilst examining this larva after death (or after apparent death), when flaccid, discoloured, and shrunk to about half its normal size, and lying on its side on blotting-paper, an apparent corpse, and without reaction to pressure by the fingers, a house-fly alighted on it and walked over it, whereon the skin was thrown into violent contraction, a striking instance of the independence of the life of parts of the insect organisation."

is present upon the second and third thoracic segments, and broadens considerably towards the intersegmental furrows, and especially towards that which separates these two segments from each other. Except on the anterior and posterior boundaries of the prothorax the band is replaced on this segment by a rather lighter and much broader patch of a brownish colour with dark spots upon it. The whole dorsal band upon the three thoracic segments is traversed by a narrow median light-coloured line lying over the dorsal vessel. The sides of the thoracic segments are also dark-coloured, the tint spreading further upwards at the intervening furrows, while, on the prothorax, the dark lateral tint extends until it is continuous with that of the dorsal patch, so that there is very little of the light ground colour on this segment. This small amount of the light ground colour is chiefly on the dorsal aspect of the segment, anterior and posterior to the brown patch, and even over these limited areas it is interrupted by the traces of the continuation of the dark band of the two segments behind. There is also a small lightish patch on the sides of the prothorax in one of the specimens, but even this is clouded with darker markings. Hence nothing could be more unlike than the arrangement of markings on the thoracic segments of these two varieties. The face is also striped with two additional dark lines, of which those on the same side are continuous inferiorly and superiorly, but do not meet those of the opposite side in a Λ. These are parallel with the margins of the dark borders of the head also present in the yellow variety. In one specimen, the nearest line has fused with the dark margin, except for a short section of its length superiorly. The clypeus is also bordered by a fine dark line. Again, the dark borders to the oblique stripes pass backwards, and meet in a V at a point considerably in front of the posterior boundary of each abdominal segment, from the first to the seventh inclusive, while, in the other variety, the borders meet at the boundaries themselves. Posterior to the apex, in the brown variety, the darker borders again diverge in a smaller V, with its apex directed forwards, and thus making an X with the other V. Each side of the smaller V is prolonged backwards to the intersegmental furrow, where it meets with the oblique border behind that with which it is continuous anteriorly. The series of seven X-like marks which are thus seen upon the first seven abdominal segments is exceedingly characteristic, and quite unlike the Vs of the yellow variety. The "eighth border" is quite distinct, and forms the first X, although it is smaller than the others, while the seventh of these markings is the least distinct. Although there seems to be some difference between the two sections of the oblique borders (being dark brown above and a lighter reddish-brown below), there is not so sharp a demarcation as in the other variety. There is apparently no trace of the oblique stripes, although there is a linear light-coloured posterior edge to the inferior anterior section of each border (as in the yellow variety). In one of the specimens I was very interested to find a distinct trace of the subdorsal line, which is present (as in the adult whitish

varieties of *Smerinthus ocellatus* larvæ) as the demarcation between a lighter dorsal and a darker lateral tint, the junction being itself slightly lighter than either. Traces of the line were also visible on the thoracic segments, and the whole marking was especially well seen on looking at the larva from a little distance so as to obtain a general impression. Again, the traces of the shagreen-dots on the dorsal surface are far less modified than in the other variety, and are accompanied by less altered dots, which are similar to those upon the lateral and ventral surfaces. Those which are modified are larger than the others and have small circular reddish patches round their centres, which are marked by the scar of the bristle which formerly existed in this position. Below the oblique borders traces of shagreen-dots are very abundant and distinct, being especially crowded upon the dark ventral surface. Each is a light-coloured circular patch, which is not raised above the larval surface. Within each patch is the dark scar, with a minute central white point, which appears to be sometimes developed into the rudiment of a bristle. The prominence of these lower patches affords a strong contrast to their condition in the yellow larvæ. Hence this strong contrast between the markings of the two varieties in a dimorphic species (quite apart from their difference in colour) seems to suggest that they may have originally belonged to different stages in the ontogeny. Whatever be the interpretation, it is quite clear that the differences are of a much more strongly marked kind than those usually expressed by the term 'dimorphism' as applied to larvæ." Powell writes (*in litt.*): "My experience of the larvæ, at Hyères, is that the brown variety of the larva of *M. atropos* only develops its peculiarities at its penultimate moult. Before that it is similar to the ordinary yellow-green and purple form after this moult. To begin with, it is a hybrid-looking thing, intermediate between the type and the variety. The last moult gives it its very distinctive dark appearance with the white marks on the first few segments." Weismann asserts (*Studies in Theory of Descent*, transl. pp. 323-324) that the larvæ in the fourth stadium are greener than the more purely yellow ones of the fifth stadium (which, however, are also frequently green), whilst some adults are of a dark brownish-grey without any striking colours. He considers that, in this dimorphism, he sees the commencement of a new process of adaptation, *viz.*, that the larva is becoming adapted to the soil in* and on which it conceals itself by day. He explains the blue-coloured stripes as being imitations of the oblique shadows of the leaf-ribs, and he says that it is "quite in accordance with this explanation that we see caterpillars with the brightest-coloured stripes concealing themselves in the earth by day, and betaking themselves to their foodplants only in the dusk of the evening or dawn of morning and even during the night, *i.e.*, in a light so faint that feeble colours would produce scarcely any effect. The bright blue of the larva of *M. atropos*, for example, would give the impression of oblique shadows without any distinctive colour." Weismann further adds: "The geographical distribution of the dark form indicates that,

* There is no evidence whatever that the larva of this species conceals itself either in or on the soil during the day.

in the case of this species also, the form referred to is replacing the yellow (green) variety, for, whilst in the middle of Europe (Germany, France, Hungary) the dark form is extremely rare, in the south of Spain this variety (*teste* Noll) is almost as common as the yellow one, and in South Africa, at Port Natal (*teste* Staudinger) the dark form is somewhat the commoner, although the golden-yellow, and, more rarely, the green, varieties occur there. I have seen a caterpillar and several moths from Port Natal, and these all agree exactly with ours. The displacement of the green (yellow) form by the dark soil-adapted variety appears, therefore, to proceed more rapidly in a warmer than in a temperate climate." Noll writes further that the larva of *M. atropos* does not, in the south of Spain, conceal itself by day in the earth (see footnote, *antea* p. 422), as with us, but on the stems or underneath the leaves. He says: "At Cadiz, on the hot sandy shore, *Solanum violaceum* grows to a height of three feet, and, on a single plant, I often found more than a dozen *M. atropos* larvæ resting with the head retracted. It can easily be understood why the lateral stripes are blue when one has seen the south European *Solaneae*, on which this larva is at home. *Solanum violaceum* is scarcely green, for violet tints alternate with brown, green, and yellow over the whole plant, and between these appear the yellow-anthered flowers and golden-yellow berries of the size of a greengage. Thus it happens that the numerous thorns, an inch long, between which the caterpillar rests on the stem, pass from violet into shades of blue, red, green and yellow." Meldola states (*loc. cit.*, app. p. 531) that Trimen noticed for many years that, at the Cape, the larva of this species varies greatly in the depth and shade of the green ground-colour, the variability being in strict accordance with the colour of the leaves of the particular plant on which the individual was feeding; the phenomenon was particularly noticeable in larvæ feeding on *Buxia grandiflora*, a shrub in common cultivation in gardens, and of which the foliage is of a very dull pale greyish-green, whilst another striking instance was noticed in some very fine caterpillars feeding on a large shrubby *Solanum*; when found on plants with bright green or deep green leaves, the colour of the larvæ is almost in exact agreement. Trimen adds: "These remarks apply principally to the underside and prolegs and lower lateral regions, the dorsal colours of violet and yellow varying but little. The protection afforded is very considerable, as the larvæ almost always cling to the lower side of the twigs of their foodplants, so that their uniformly-coloured undersurface is upwards and turned towards the light and their variegated upper surface turned downwards." That the number of larvæ of the dark form varies much, in Britain, from time to time is noted by Anderson (*Ent. Rec.*, vii., p. 40) who observes that, although he has in various years had a great number of larvæ of this species, he had only had the green form until 1896, when he had several which, instead of being of a beautiful apple-green tint with violet and yellow streaks, were of a dingy brown colour with a latticed pattern of dull blackish-purple on the sides and back, and a sprinkling of dirty white spots, the anterior segments being white, with two stripes broken up into spots a little darker than the general colour of the body; whilst he adds that both the green form and the variety have a similar whitish warty caudal appendage. Burrows gives (*Ent. Rec.*, v., p. 220) a detailed descrip-

tion of the very rare dark olive-red form of the larva mentioned by Stainton (*Man.*, i., p. 89), the specimen described being taken at Rainham, on potato, on August 11th, 1894. Thorpe notes (*Ent.*, v., p. 143) taking 120 larvæ at Blackpool, in 1868, 11 of which were of the olive-brown form, with darker lateral stripes (from these 45 imagines were bred), whilst in August, 1869, 24 larvæ were taken in the same district, three being of the olive-brown form (20 of these had pupated by September 28th, and between April 28th and May 28th, 1870, 14 ♀ s and 3 ♂ s emerged). Anderson notes (*Ent.*, xviii., p. 243) a larva taken in August, 1885, which "was entirely minus the caudal horn, the position where it should have been being decorated with two bright yellow spots and a perpendicular black streak."

Cocoon.—For pupation the larva goes down 8 or 10 inches into the earth and there makes an oval chamber very much larger than the enclosed pupa (Hellins). The puparia are made in earth from earth; there is no silk (or very little) in its structure, the inside has the appearance and polish of damp earth that has been well beaten (Réaumur). The puparium consists of a compact cell, the earth composing which is mixed with gum discharged from the mouth * of the larva and kneaded into a kind of paste or mortar (Newman). The larva buries some inches below the surface, and forms a large hollow cavity by opening or cementing the earth over and around it, and so evidently obtains a more equable temperature and amount of moisture (Jefferys). The vaulted puparium, made several inches below the ground, is larger than a hen's egg, the inside being made smooth and firm by means of a fluid passed from the anus.* The larva does not change to a pupa for some 14-16 days after it has made its puparium. The puparium is exceedingly brittle, but, for emergence, the moth softens the pupal shell with an acrid juice (Bartel). In nature, the puparium appears to be made at a depth of about 6ins., the pupæ being readily turned up by the potato-plough and appears about midway in the furrow. In captivity, the larvæ sometimes pupate without hesitation upon the surface of the earth. There is not the slightest cohesion in the sides of the cell in which the larva of *Manduca atropos* pupates, and, in only a few cases, was it possible to secure small pieces of the side to examine; there appears to be no trace of silk and very little of gum used in its preparation. The chief thing discoverable has been the impression of the face upon the inner surface, which was fairly smooth save for these impressions, and looks as if the inside of the puparium is smoothed by the larva pushing its head against it. It is totally impossible to extract a puparium whole. The cavity is formed horizontally and appears to provide plenty of room for the pupa to bend and turn, though there is little to spare in the length (Burrows). Sharp notes (*Ent.*, xxix., p. 327) that the larvæ do not make puparia of a solid character, but each one, about an inch or two below the surface, reduces the soil to a very nice uniform condition of fineness, for an area of a quarter of an inch or more around itself; this prepared soil is only fastened together so very lightly that a very slight

* These remarks want careful comparison; one suspects that one of them, at any rate, must be erroneous. The fluid used is not likely to come both from the "mouth" and the "anus."

disturbance ruptures it. He states that he wished to examine one of these pupating larvæ to see the conditions of the resting-stage, so broke the earthen cocoon of one, and then put it together, as he thought, very nicely; a deformed pupa was, however, produced. Inchbald says that the larvæ bury several inches into the soil where they make an earthen cocoon of minute granules of earth and sand with a few tiny stones intermixed, and adds that there is no silken material used. Morres notes that the puparia are so fragile, that, in 1897, he had some 7 or 8 larvæ go down in their several pots, that these were placed on a table from which they had to be frequently moved backwards and forwards, and that, on turning out the pupæ, he found them crushed and flattened out of shape, the walls of the slender cells having evidently been shaken down on the newly-formed pupæ. In spite of the brittleness of the puparia, it has frequently been found that, by allowing the earth in which they have been formed to become very dry, the imagines have matured, and then been unable to emerge (see Anderson, *Ent.*, xi., p. 188). Occasionally, as stated by Burrows above, the larvæ pupate without forming puparia. Instances of this kind are noted by Réaumur (*Mémoires*, ii., p. 295), Anderson (*Ent.*, xi., p. 188), Cotton (*Ent. Rec.*, xii., p. 275), &c. Hopson records (*Ent. Rec.*, xii., p. 346) a larva going underground, coming up to the surface again, remaining in a shrunken condition for 14 days, and then pupating, the newly-formed pupa taking 3 days to assume its normal tint. Pabst also asserts that pupation does not actually take place till 14-16 days after the larva has constructed its cocoon. Sander says (*Kleine Schriften*, i., p. 342) that some larvæ pupate almost directly after ceasing to feed, whilst others lie a long while, often 6-8 days. As offering a connection between the puparium and pupal habits, Anderson writes (*Ent.*, xi., p. 188): "Two larvæ, in September, 1877, pupated on surface and ten buried; of the two pupæ on surface both matured imagines in November, 1877, of which one imago emerged and one died; of the others, one emerged before April and had died in the puparium owing to the fine earth having got dry and hard; two other pupæ were then dead; the rest were taken from their puparia and laid on moss in greenhouse, and all produced imagines between June 18th and July 5th, 1878.

PUPA.—The newly-formed pupa * is of a bright yellow colour, the posterior abdominal segments becoming pinkish-red shortly afterwards, the whole skin gradually hardening and deepening in colour till it reaches a logwood-brown, &c. (Graham). This large pupa is of the rich deep brown colour common to subterranean pupæ. It has the S-curve that is associated with antero-posterior flattening in the higher Sphingids (*Amphonyx*, &c.) and in the Sesiines. The curving here is chiefly caused by a hollow, towards the end of the 1st legs in front, and to the projection of the maxillary bases, all that is left of a once probably existent proboscis-horn, the apex of the head being in front of the axial line, the dorsal line sloping forwards at the prothorax. There is very little forward curve in the abdominal segments. The hollow in front of the legs is very reminiscent of the similar recession in *Amphonyx*,

* Schröter says (*Naturforscher*, xxi., 66) that the pupa is at first wholly white, that the abdomen first acquires its brown-red colour, the upper part becoming first yellow and then finally brown, the full colouring only being acquired after about 24 hours.

&c., obviously provided for the easier accommodation of the great curved horn. The measurements (♀ pupa) are:—

MEASUREMENTS AT	LENGTH FROM FRONT.	ANTERO-POSTERIOR DIAMETER.	DORSAL OF AXIS.	VENTRAL OF AXIS.	TRANSVERSE DIAMETER.
Prominence in front of glazed eye	3·0mm.	9·0mm.	2·0mm.	7·0mm.	10·0mm.
Outer angle of maxilla ..	6·0 ,,	13·0 ,,	5·0 ,,	8·0 ,,	11·0 ,,
1st spiracle	10·0 ,,	14·0 ,,	6·5 ,,	7·5 ,,	14·0 ,,
End of 1st tibia (prominence)	12·0 ,,	14·0 ,,	7·0 ,,	7·0 ,,	15·5 ,,
Middle of wing-base .	14·0 ,,	15·0 ,,	8·0 ,,	7·0 ,,	16·5 ,,
End of antenna (top of mesothorax)	18·0 ,,	15·0 ,,	9·0 ,,	6·0 ,,	18·0 ,,
End of 1st leg (thor.-abl. incision)	22·5 ,,	15·5 ,,	8·5 ,,	7·0 ,,	18·0 ,,
End of 2nd leg (2-3 abl. incision)	31·0 ,,	17·5 ,,	9·0 ,,	8·5 ,,	18·0 ,,
End of wing and maxilla	40·0 ,,	17·5 ,,	8·5 ,,	9·0 ,,	18·0 ,,
Spiracle 5th abl. segment	45·0 ,,	15·5 ,,	7·8 ,,	7·7 ,,	17·5 ,,
,, 6th ,, ,,	51·0 ,,	15·0 ,,	7·4 ,,	7·6 ,,	16·0 ,,
,, 7th ,, ,,	56·5 ,,	12·5 ,,	6·3 ,,	6·2 ,,	13·0 ,,
Obsolete spiracle of 8th abl. segment	58·0 ,,	10·0 ,,	4·2 ,,	5·8 ,,	10·5 ,,
9-10 incision	62·0 ,,	6·0 ,,	2·2 ,,	3·8 ,,	7·0 ,,
Base of anal spine	64·0 ,,	2·5 ,,	2·0 ,,	0·5 ,,	4·0 ,,
Extreme length =	68·0 ,,				

This length would vary according to the extension of the free incisions. A comparison of the columns 3 and 6 gives a measure of the amount of the flattening and its distribution. The measurements would, no doubt, be more luminous if they could be referred to an axial line. An attempt to do this is made in columns 4 and 5, where the measurements in column 3 are divided into those dorsal and those ventral to an axial line or rather plane drawn from the ventral margin of the antennal attachments, and continued down through the centres of the spiracles of the 4th abdominal segment, the movable segments being placed with their spiracles medially on the plane, the pupa looking in this way in a normal attitude. Of course, a different position of the ventral segments would alter the measurements referring to them. The measurements were made by fixing the pupa on its side with a line beneath it, and another (by a stretched thread) above, fixing a plane, the supposed axis being where the medial plane crosses this. These figures show bending ventrally in first three measurements (head and prothorax), an average position just behind this, a dorsal prominence thence to end of 2nd leg, the venter slightly predominating again at the end of wings. The abdominal segments predominate ventrally, though the axis is chosen so as to make the anal spine almost entirely dorsal. These measures are fairly accurate and are not difficult to make on so large a pupa without any special apparatus. The anterior extremity of the pupa is about the middle of the epicranium, from this point it slopes forwards about 3mm. receding about 1mm. to the labral margin, dorsally it recedes 3mm. or 4mm. in the same distance. The labrum is square against the maxillæ and has two faint tubercles. A suture extends upwards from its

angles probably marking off (so far) the clypeus; the anterior convexity of the head terminates laterally in a prominence in front of the glazed eye, bending round here and keeping the head of hardly increasing diameter across the glazed eye to the 1st leg, the glazed eye points almost directly anteriorly, the epicranial angles near mandible show several small tubercles. The sculpturing of head is labyrinthine (or like cerebral convolutions), but so pressed down and flat as to give a smooth surface and only shows the sculpture by a network of fine lines. The proboscis has a considerable prominence near its origin standing up as a rounded keel till about 6mm. from its origin, where it is the most prominent part of the front of the pupa; at first narrow between the cheeks, it then widens out and forms an angle where the 1st leg meets the eye; either side measures 7mm. from middle line to angle, but sloping backwards, it is only some 10mm.-11mm. from angle to angle; it proceeds, gradually narrowing, to wing apex, some 40mm. The greater part of the maxillæ is very smooth, though fine lines representing sculpture may be seen with a lens. The basal 7mm. or 8mm., however, are marked by very strong transverse ridges so as to be almost like a file. These probably represent the similar rugæ which usually clothe the proboscis-case of *Sphingidi*, which no doubt existed here in the Manducine ancestor. This rough area is always present but varies a good deal in its extent, an item no doubt supporting the view that it represents the lost ancestral horn. The antennæ show every joint very distinctly, although they are very smooth and polished. Each joint has a basal smooth, and a distal finely striated, portion; just against the 1st spiracle the margin is a little widened and is occupied by irregularly marked areas. Basal to the antennæ there is marked off a triangular area on the dorsum of the head, with two tubercles and a definite sculpturing. The glazed eye is an uniform smooth area, with its anterior convex margin "glazed" and, beyond this, a narrow band with radiating sculpture. The prothorax has a central suture (functional on dehiscence) and sculpturing so fine that, without a lens, it has little other effect than to make the surface dull, instead of polished, the fine lines are, in some degree, concentric to a point about the middle of each side and another dorsal near the hind margin. The 1st spiracle is nearly 4mm. long (*i.e.*, the surface opening), the posterior margin projects over it as a narrow smooth margin, looking like a lid just raised from the aperture. The first legs have an equal margin against eye and antennæ, are wide (4·5mm.) and large, and have an elbowed projection (at end of tibia?). Between them and the maxillæ is a fusiform strip, 8mm. long and 1mm. wide at middle, the 1st femur. The 2nd leg is narrower than the first (3mm.); the sculpturing of the legs is in very fine lines only to be seen with a lens. The mesothorax and wings are very smooth, but there is some appreciable sculpturing dorsally—in transverse labyrinthine wrinkling, and there is a dorsal suture, not functional, and usually much obscured. There is the smooth subdorsal suture, marking off the wing-bases (inner line of patagia), the sculpturing of wing-bases is abundant and complex, but exceedingly smoothed down and not easily appreciated without a lens. The wings, smooth as they are, are very beautifully and regularly, though

extremely minutely, sculptured by fine lines, and the nervures are easily seen. Poulton's line cuts off a narrow (1mm.) margin. The metathorax presents two great characteristic callosities. These are oval (except that they almost meet in a point dorsally), about 5mm. each across and 1·8mm. from front to back; except a median ridge, the rest of the segment is very smooth though it may have a few irregularities. The callosities are as though a layer of pitch had been put on, and circular pits of some depth impressed in it so closely as to deform each other and leave between them narrow sharp ridges, the pits about 0·25mm. wide. The floors of the pits are level, so that the ridges between them might be described as walls of fairly uniform thickness. The narrow strip of the hind-wings recedes from the 2nd abdominal spiracle and disappears opposite that of the 3rd segment. The abdominal segments are less smooth than the thoracic. Their anterior margins are pitted most strongly dorsally, the rest of each segment is wrinkled in fine transverse lines, with fine pits slightly intruding. On the 7th abdominal segment the pits reach the hind margin. Subsegmentation is not well marked, the intersegmental subsegment is easily distinguished on the 3rd abdominal, and on the 1st and 2nd an anterior subsegment is fairly distinct, the intersegmental one less so, whether the intermediate area is or is not subdivided is largely a matter of personal equation, but in some degree of the specimen examined. The most notable features of the abdominal segments, and in some degree of the pupa itself, are the prespiracular flanges on segments 5, 6 and 7, largest on 5 and smallest on 7, they are otherwise almost identical on the three segments. The flange consists of a sharp edge about 5mm. long; in front of this edge the surface is flat, smooth, and facing directly forwards, with a width of about 1mm., behind, the surface is rounded, but may better be described by saying that the surface of the segment, instead of being curved down to the incision, continues directly forwards, with very little final outward curve to the sharp margin of the flange. When the segments are flexed, the anterior flat surface of the flange comes against the posterior margin of the segment in front, which is full and rounded in such a way that the flange fits against it, and the side of the pupa is smooth and level. On the opposite side, where the segments are extended, each incision is rather a deep gap, with the flat surface of its posterior lip directed forwards, and the margin is a very sharp edge. One cannot help noticing that the side of flexure will slip smoothly on anything, but that the extended side presents a series of notches with very sharp, almost hooked, margins, and flat surfaces on their posterior edges, so as to present a determined impediment to the pupa slipping forwards. This is at once appreciated on drawing the finger along the side, first flexed then extended. There can be no doubt that these flanges, developed in some Eumorphids to enable the pupa to leave the puparium, have here precisely the opposite function, *viz.*, that of a cremaster, to prevent the pupa-case accompanying the moth on emergence. The spiracle lies in a little hollow behind the anterior portion of the flange. In front of the flange is a little series of curved transverse rugæ. The ordinary form of the cicatrices of prolegs on 5 and 6 is as slightly depressed smooth areas with faint striæ or wrinklings radiating from

them to the ordinary sculpture. On these segments are several depressed spots. One of these is a little outside and anterior to the proleg cicatrix; fully developed, it is a raised ring with a central pit. A similar smaller one may exist between it and the scar, and two other very minute ones are associated with it closely in a line extending outwards and backwards. Another is directly in front of this at the anterior border of the segment, and looks as if a group of the ordinary pits had been closely aggregated into a depressed spot. Various other arrangements of the sculpture seem to be peculiar to particular spots, but description would be interminable and not by any means luminous. The scar of the larval horn is like that of the prolegs, a smooth spot with radiating lines. There is no hollow behind it, but, instead, are usually two small tubercles, one on either side, and, occasionally, a third behind them in the middle line. The anal spike, 3·5mm. long, 3mm. wide and 2mm. deep, is very coarsely mammillated with rounded convolutions, and ends in a small bifid spine. Its undersurface has a longitudinal groove. The anal scar is marked by a longitudinal groove about 2·5mm. long, with several fine parallel ridges. The male tubercles are large and flat, quite symmetrical and well separate from front margin of 9th segment, but encroach by about as much on 10th. On the 8th segment are obscure markings as of an obsolete paired arrangement; this is sometimes fairly distinct, in other specimens hardly visible. The female area presents the ventral aspect of 8, 9 and 10 smoothed out, without trace of the segmental incisions, but with two or three swellings marking the line of hind margin of 8. The anterior two-thirds of 8 is marked by a central impressed line, with deeper pore-like spots at each of its ends and usually another smaller centrally. There is a good deal of variation, and either of these three may be obsolete. In one specimen the posterior one is advanced to the middle of the segment, and has two small mammillæ just like the male tubercles, but smaller; in another the slit is confined to the front margin of the segment and cannot be differentiated. In one specimen the anterior margin of 9 is very distinct as a fine line and comes forward and encloses the posterior pore. In a small starveling specimen, 51mm. long (normal length 65mm.-70mm.), the claspers are represented by large rounded bases on either side of the front end of the anal scar, and there is the depression behind the scar of the larval horn, so common in Sphingid pupæ, but quite absent in all normal pupæ of *M. atropos.* The exaggerated larval scars are due to weak development of the pupa, partly by larval characteristics not being vigorously thrown off, but chiefly from want of promptness and quickness in moulting the larval skin, which allows the soft pupal skin to begin to harden within the larval skin as a mould, instead of the larval skin being got rid of before any hardening commences. Carried a little further, the same weakness results in the larval skin being only partially cast, or even not cast at all. Microscopic hairs occur around each spiracle to the number of 8 or 10, but elsewhere are very scarce, not so numerous as if they represented the ordinary tubercles only. The pits, as transparent objects, look very like those fish scales that radiate from a centre, or crystallisations that form a radiating arrangement; the margins are sinuate, and to the sinuations darker and lighter shades radiate from a central point

(Chapman). Poulton describes and figures (*Ext. Morph. Lep. Pupa*, pp. 204-205, pl. xx., figs. 15-19) the terminal abdominal segments of the pupa of this species. Fig. 15 (× 9) shows "the median ventral part of the last three segments of a ♀ pupa. Both generative openings are distinctly visible in this individual; the opening of the oviducts is large and surrounded by a thickened V-shaped lip. It is placed in front of the apex of the median prolongation of the 10th abdominal, and appears to be clearly situated in an anterior median extension of the 9th abdominal segment. The opening into the bursa copulatrix is immediately in front of the other aperture, but separated from it by the boundary between the 8th and 9th abdominal segments. The opening extends forward as a narrow median slit as far as the anterior boundary of the 8th abdominal. The anus (A) is distinct on the 10th abdominal. The sculpture on the surface of the pupa, and the various wrinkles, &c., are carefully copied in the figure. These details required for their elucidation the most careful examination of an especially favourable individual in a very strong light. The general resemblance of the generative apertures to those of a well-marked individual of *Cossus cossus (ligniperda)* is very striking (figs. 27, 29). Fig. 16 exhibits the last three segments of a ♀ pupa seen from the ventral aspect, and of natural size. The generative apertures could not be made out without magnification but the median prolongation was very distinct, far more so than in the last figure. In front of the anus (A), at the base of the median prolongation, there is the deceptive appearance of an opening with lips, due to wrinkles in the pupal case. The true generative openings never assume so posterior a position. In fig. 15 the true nature of the marking is apparent. Fig. 17 (× 9) represents the median ventral area of the 9th and the anterior part of the 10th abdominal segment of a ♂ pupa. The figure hardly needs description as the ♂ organs are quite typical. The lateral tubercles are roundish and somewhat flattened. The sculpture of the surface is represented. The exact relation of the ♂ organ to the boundary between the 9th and 10th abdominal segments varies greatly in different species (compare figs. 11, 20, 21, 23). Fig. 18 represents, of natural size, the last three segments of a ♂ pupa seen from the ventral aspect, and shows the appearance of the ♂ organ when looked at without magnification. Fig. 19 (× 2) exhibits the median ventral area of the 9th and the anterior part of the 10th abdominal segments of the pupa represented in the last figure (18), showing the form of the ♂ organs with greater distinctness. The three minute pits in front of the reproductive organ are probably merely an accidental conformation of the cuticle, for they are not found in other individuals (compare fig. 17)." Two pupæ measured respectively 60mm. and 70mm. in length. The figure of the pupa is somewhat elongated, fairly cylindrical, the head and eyes rather projecting, the outline of the back sloping up gently to the thorax, and then going nearly on a level except the segmental folds, to the 3rd segment from the tail, whence there is a rapid slope; on the underside the thorax is somewhat hollowed out and the wingcases swell out a little. The segments of the abdomen are well-marked; the tail ends in a large, thick, flattish, rough spike, with two very short, stout spines. The skin is glossy but somewhat sha-

greened on the back at the segmental divisions, and there are two very rough pear-shaped spots between the thorax and abdomen. The colour is rich mahogany-brown, clouded in places with a darker brown (Hellins). The age and sex of the pupæ have much to do with their weight, and the sex also influences size in many cases (see Meldola, *Annals and Magazine of Nat. History*, ser. 4, vol. xii., 1873). Fryer gives the weight of some pupæ of *M. atropos* collected in 1900 as follows:—

14 collected in September—Greatest weight, 11·945 ..	Least weight, 7·706 grammes	
	Mean weight, 9·004	,,
7 ,, ,, October—Greatest weight, 12·515 ..	Least weight, 8·387	,,
	Mean weight, 10·340	,,
Mean weight of 21 pupæ	9·472	,,

Russell notes (*Ent. Rec.*, xii., p. 345) that, of five pupæ that he measured, two were 2¼in. and three 2¾in. in length. Mitchell records (*Ent.*, xxiv., p. 76) an instance of a pupa in which, after the larval skin had been successfully shed, the fluid contents of the pupa were discharged through the wings which assumed a most abnormal globular form. Glenny states (*Ent. Rec.*, xiii., p. 157) that "it is quite easy to distinguish during the day the pupæ from which imagines will emerge at night, since the wings dry away from the wing-cases, and the yellow and blue-black markings of the body are quite easily discernible."

Pupal habits.—The pupal stage varies from a few weeks to many months, those pupæ that are formed in July and August may emerge in from 6-8 weeks, or they may go over until May-July of the following year. Sharp observes (*Ent.*, xxix., p. 327) that the pupa of this species is excessively active with its abdominal segments. The abdominal segments 6-8 of the pupa are very deeply impressed and ridged on each side, and this condition is correlated with the capacity of movement,* for, though this sculpture looks quite shapeless, yet, when the pupa is fully bent laterally, the largest ridge, close to the stigma, exactly fits to the side of the preceding segment. (See also Chapman, *antea* p. 428.) Morres also says that a healthy pupa of *M. atropos* is exceedingly lively, so that, unless one is careful in handling them, they will sometimes nearly wriggle out of the hand. It is, he says, remarkable how different is the movement of the pupa if it has lain long in the ground. After some time, say a couple of months, they are often quite quiescent, and scarcely move at all, sometimes being so stiff as to lead one to suppose that they are dead. As to the time in which the pupal stage is reached in Britain, *i.e.*, the period at which pupæ may be found, refeience must be made *antea* pp. 408-413. Burrows writes (*Ent. Rec.*, xiii., p. 156): "The earliest date—spread over a series of years—on which pupæ have been brought to me, is September 2nd, 1894, at Rainham, and the latest on October 20th, 1900, at Mucking, a period really coincident with the potato-digging. The pupæ, when in health, are remarkably active; on receiving their morning

*A remarkable statement occurs (*Ent. Rec.*, vi., p. 58) that the pupa has no free segments and so canuot work its way through the earth. The pupa, of course, has the normal number of free segments for Sphiugid pupæ, but, in common with most other obtect pupæ, does not leave the puparium on the emergence of the moth.

bath they wriggle, and appear to make a bubbling sound as though they were drinking. Some 24 hours before emergence, the shell having become detached from the imago, the latter squeaks loudly. Burrows further states that, in forcing the pupæ, he exposes them to a damp heat of 80° F. to 90° F., which he finds sufficient to make them emerge in 8 days. Mathew says that, before emergence, the pupæ change colour and finally become nearly black, and, at this period, feel very soft to the touch, and, if handled a few hours before emergence, the moth may be heard squeaking within. Levett says that the pupa becomes dark and soft and turns on its back shortly previous to the emergence of the imago. Verloren notes (*Alg. Könst- en Letterbode*, 1847, pt. 2, p. 147) that the pupa may be induced to utter a noise, though fainter than that made by the imago. Bartel says (*Pal. Gross-Schmett.*, ii., p. 19) that "a more crackling but somewhat weaker sound than that made by the larva is also made by the pupa just before the disclosure of the imago." All other observers state that the sound made by the pupa is like that made by the imago, in fact, that it is made by the contained imago. Anderson notes (*Ent.*, xviii., p. 324) that the noises made by the pupa and moth are nearly identical, though, in the case of the pupa, it is somewhat fainter, and is a shrill grating squeak, not unlike that of the dolls which, on being squeezed, give forth a cry. Pearce observes (*Ent.*, xix., p. 44) that the sound which is made by the pupa was heard on December 17th, 1885, and was produced by pressing the thorax of one of which he was doubtful as to whether it was alive. Thinking the moth could not release itself, he removed the pupal covering from the eyes and tongue; the sound was then repeated, and it was noticed that the extended tongue was raised in the middle in the form of a bow and divided at the same time from the mouth nearly to the tip, and then quickly depressed and closed, the sound being apparently produced by the junction of the two tubes. Whether this be so or not, the experiment proves distinctly that the sound made by a pupa comes really from the contained imago. Newman also notes that the pupa possesses the power of uttering a distinct sound, but this is rather like a sharp short squeak repeated at intervals, then the crackling sound of electric sparks. Morres states that when handling the pupæ he has heard them emit the same sound as the moth. Moss records that a ♀ pupa, unearthed on November 16th, 1900, squeaked several times when handled on November 20th, a ♀ imago appearing on November 24th.

FOODPLANTS.—Almost polyphagous (Merrin), *Solanum dulcamara* (Buckler), *Jasminum* (Albin), *Fraxinus excelsior*, *Jasminum officinalis*, *Lycium barbarum*, *Solanum dulcamara*, *Datura stramonium*, *D. tatuta D. metel*, *Physalis alkekengi*, *Nicotiana rustica*, *N. glauca*, *N. tabacum*, *Ligustrum japonicum*, *L. vulgare*, *Syringa vulgare*, *Patelovnia imperialis*, *Yochroma tuberosa*, *Euonymus japonica*, *Spiraea trilobata*, *Solanum esculentum*, *Lycopersicum esculentum*, *Solanum tuberosum* (Siépi)*,

* Dr. Siépi has taken the larvæ frequently in the Marseilles district, where they are very rarely found upon potato, although frequent on many other plants, which he has arranged above in order of preference, by which it will be seen that "ash" is the most favoured and "potato" the least favoured foodplant in that district.

Rubia tinctoria, cabbage (Pabst), *Solanum sodomaeum* (Walker), *Sesamum orientale* (Lewis), *Convallaria majalis*, *Daucus carota* (Macho-Velado), *Philadelphus* (Rühl), *Cannabis sativa* (Kranz), *Euonymus europaeus* (Ochsenheimer), apple (Moss), dock and plantain (J. A. Clark), privet (Routledge), *Solanum persicum* (Christoph), nettle (Kleemann), *Ruta graveolens*, nettle (Stone, *Ent. Wk. Int.*, iv., p. 147), chrysanthemum, olive (Powell), dogwood (Jones), *Olea europaea* (Calberla), *Lonicera caprifolium* (Hufnagel), prefers hemp to potato (Kühn), *Pyrus communis* (Scopoli), *Solanum nigrum* (Cardano), *Solanum melongena*, *Lycium europaeum*, *Zygophyllum fabago*, *Fragaria vesca*, *Sambucus nigra* *Erigeron canadensis*, *Syringa vulgaris*, *Jasminum grandiflorum*, *Catalpa syringaefolia*, *Bignonia catalpa* (*teste* Bartel), *Faba vulgaris* (Boisduval), snowberry (Lighton), *Buxia grandiflora* (Trimen), *Vitex agnus-castus* (Rösel), *Atropa belladonna*, *Lonicera periclymenum*, mulberry, pear, strawberry (*teste* Newman). [Bartel notes that "the larvæ that have so far been found on *Nicotiana affinis* and *N. glauca* have been of the green form; on *Vitex agnus-castus* only the dark form of the larva has been found"; he adds that Calberla observed a larva in central Italy in November that had eaten an olive twig bare, and notes that it is remarkable that larvæ are so rarely found on tomato, which is so nearly allied to potato; Horváth notes the larvæ as sometimes injuring the potato crop in Hungary, although, even here, the food-plant appears generally to be *Lycium barbarum*; he adds that "the natural foodplants appear to be Solanaceous plants, others only seem to be requisitioned by the ♀ when *Solanaceae* are not available."] Mansel-Weale states (*Proc. Ent. Soc. London*, 1878, p. 5) that, in South Africa, the ordinary form of larva generally feeds on *Solanaceae*, whilst the darker and rarer variety is found only on species of *Lantana*. Leigh gives sweet potato, tomato, a large-leaved thistle, a small-leaved climbing-plant, and a species of bramble as the foodplants, at Durban. Clark asserts (*Zool.*, 1853, p. 4107) that some larvæ in his possession preferred slices of the tuber of potato to the leaves, and that they ate the former voraciously when they refused the latter. Aigner-Abafi gives (*Illus. Zeits. für Ent.*, iv., pp. 177-178) the following list of recorded foodplants under their natural orders. SOLANACEÆ: *Datura stramonium*, *Solanum tuberosum*, *S. nigrum*, *S. dulcamara*, *S. lycopersicum*, *S. melongena* (in Java *, Madras,* Sicily), *S. trilobum* (Ceylon *), *S. persicum* (Transcaucasia), *S. candens*, *S. esculentum* (North Africa), *Nicotiana tabacum* (Java,* Borneo,* Philippines *), *N. glauca* (Italy), *Atropa belladonna*, *Lycium europaeum*, *L. barbarum* (Tiflis, Africa), *L. afrum* (North Africa), *Physalis alkengi*, *P. somnifera*. BIGNONIACEÆ: *Catalpa bignonioides* (North Africa). VERBENACEÆ: *Vitex agnus-castus* (Italy), *Stachytarpheta indica* (Ceylon*). OLEACEÆ: *Syringa vulgaris*, *S. persica* (Java,* Madras*), *Fraxinus excelsior*, *Ligustrum vulgare*, *Olea europaea* (Italy), *Nyclanthes sambac* (Ceylon*). JASMINACEÆ: *Jasminum officinale*. RUBIACEÆ: *Rubia tinctorum*. CAPRIFOLIACEÆ: *Sambucus nigra*, *Lonicera caprifolium*, *Symphoricarpus racemosus*. COMPOSITÆ: *Erigeron canadense*. URTICACEÆ: *Urtica* sp. MORACEÆ: *Morus* sp. CANNABACEÆ: *Cannabis sativa*. CHENOPODIACEÆ: *Beta*

* These localities suggest that Aigner-Abafi does not separate *M. styx* from *M. atropos*.

vulgaris. CRUCIFERÆ: *Isatis tinctoria*. ZYGOPHYLLACEÆ: *Zygopyllum fabago* (Transcaucasia, Syria). RUTACEÆ: *Ruta graveolens*. CELASTRACEÆ: *Euonymus europaeus*. CORNACEÆ: *Cornus sanguinea*, *C. mascula*. UMBELLIFERÆ: *Daucus carota*, *Anethum graveolens*. PHILADELPHACEÆ: *Philadelphus coronarius*. AMYGDALEÆ: *Prunus domestica*. POMACEÆ: *Pyrus communis*, *P. malus*. ROSACEÆ: *Fragaria vesca*. CUCURBITACEÆ: *Coccinia indica* (Ceylon*). LEGUMINOSEÆ: *Vicia faba-vulgaris*.

PARASITES.—*Argyrophylax atropivora*, Rondani (Brauer), *Masciera pratensis*, Mg., emerged from pupa in April (Wachtl), *Choetolyga (Nemoraea) xanthogastra*, Rondani, about a dozen from one pupa (Riedal), *Blephoripoda scutellata*, R.D. (Theinert), *Ichneumon grossorius*, Grav., always singly (Rudow), *Amblyteles palliatorius*, Grav. (Marshall), *Amblyteles cerinthius*, Grav. (Scott), *Amblyteles laminatorius*, Wsm. (*proteus*, Christ), commonly (Rudow), always bred singly (Bignell); *Trogus lutorius*, Fab. (Curtis). The larvæ are, at Hyères, very liable to be infested with the grubs of a large fly, something like a housefly and about twice the size; one does not become aware of their presence until long after the pupa has been formed; then the pupa turns black, becomes soft and flabby, and breaks open to let out a mass of the grubs of this fly, which immediately pupate; I have sometimes lost as many as 8 out of 10 pupæ in this way (Powell). Two parasitical larvæ made their exit through a small hole in the wing-cases of two pupæ of *Manduca atropos*. The pupæ were not killed, but four hours after the emergence of the larvæ, two perfect ♂ moths came out; in the edge of the upperwing on each side were two small holes about the size of a quill, otherwise the insects were perfect † (Von Glehn, *Entom.*, iii., pp. 28-29). Bartel notes (*Pal. Gross-Schmett.*, ii., p. 18) that "the larvæ are only attacked by Tachinids and other parasites in the south, their enemies being apparently unable to follow the species in its wanderings north; in Germany parasitised larvæ are scarcely ever found, although Huwe records one from southern Germany; stung larvæ are more commonly observed in Dalmatia (*e.g.*, in 1889) and in Hungary." One suspects from our records that Bartel's generalisation is based on too slender data. Marshall notes (*E.M.M.*, xxxii., p. 265) an imago of *M. atropos* that was eviscerated by Morres, and was found to contain a large parasitic maggot above 10mm. in length, possibly a larva of one of the true Ichneumons. Morres noticed that the *M. atropos* larva, which was about two-thirds grown when it came into his possession, exhibited a black speck on its body, from which it was inferred that it was ichneumoned; Marshall observes that, in the ordinary course of things, the parasitic larva would have lived through the winter in the pupa of *M. atropos*, but that the forcing of the pupa, so that the moth emerged after a very short pupal period, left the parasite no time to cause its death, nor was the exhaustion of

* See footnote on preceding page.

† We own to more than a suspicion of doubt as to the observation on which this statement is based. We are struck: (1) With the fact that a hole in each upperwing would represent that the larva had bored right through these upperwings without injuring the lower ones directly beneath and in contact with them. (2) That two moths, injured in so peculiar a manner, should not only be similarly injured, but emerge in exactly the same time from the pupa, after the exit of the parasitical larvæ.

the vital juices sufficient to prevent the final metamorphosis. Hence the phenomenon of a half-grown parasitic grub being found in the body of a perfect moth.

HABITS.—Scarcely anything is known of many of the imaginal habits of *Manduca atropos*, *e.g.*, its mode of flight, the duration of its flight, its mode of copulation, habits when egglaying, &c. TIME OF FLIGHT: The evidence we have, points to the species being entirely an evening and night flier, and such records as that made by Birchall (*Ent. Mo. Mag.*, xv., p. 107) of the insect flying in the afternoon, at 3 p.m., must be looked upon as quite exceptional, as must Studd's observation (*in litt.*) of one flying over a croquet-ground in the daytime at Oxton. Boscher says that he saw one flying at sunset at Twickenham in October, 1859 (*Ent. Wk. Int.*, vii., p. 27). Schröter says (*Naturforscher*, xxi., pp. 76-77) that he found the imagines active only at the dusk of evening or morning, and neither in the dark nor in strong light. Walker records (*Ent. Rec.*, viii., p. 244) that, on September 13th, 1896, he noticed one flying round a chimney-stack at dusk, and that it shortly afterwards flew near the ground and then into an outhouse, where it was readily secured. RESTING-PLACES: Its resting-places are varied, and apparently a matter of chance, *e.g.*, on a stone, near Hayton (Armstrong), on a wall, at High Wycombe (Peachell), and at Welbeck Abbey (Rolfe), on the stone steps of a church, at Reading (Holland), on a door-frame, at Lincoln (Musham), in a cellar, at Ramsey (Clarke), on linen hanging on a clothes-line, at Bramfield (Pyett), &c., whilst a ♀ found resting on a potato-stem, at Ringwood (Fowler), one beaten out of ivy in the afternoon at Portland (Sykes), and another crawling over dead leaves, at the foot of a tree, quivering its wings and squeaking, at Ardpeaton, suggest much more natural hiding-places. PAIRING: Head notes (*in litt.*) that it is a most difficult species to pair in confinement, and of five dozen reserved for breeding purposes, in 1901, only one pairing was obtained, *viz.*, in July, and this after the moths had been out three weeks; the ♀ was kept five weeks, but she did not develop her eggs, and the ♀s opened showed no signs of egg-development *, whilst

* Verloren publishes (*Alg. Konst- en Letterbode*, 1847, pp. 146-147) a somewhat similar experience; he bred about 20 imagines in September and October, 1846, from pupæ, got some to pair, but the ♀s died without laying an egg, and he found none in the abdomen on dissection; from this he concludes that only the imagines that emerge from overwintering pupæ are able to propagate the species. Most autumnal-emerging ♀s are asserted (*Ent.*, ii., p. 283) by Newman to be barren, whilst early summer-emerging ♀s from hybernated pupæ are said to be full of eggs. He quotes Doubleday in support of these views, the latter stating that the first pupa he possessed disclosed a ♀ in July, and that she was full of eggs, whilst in the autumn of 1846, he had many pupæ, 8 or 10 of which produced moths in September-October, all the ♀s being barren and their abdomina empty. Newman describes the abdomina of these autumnal-emerging imagines as "an empty cylinder containing neither eggs nor ovary," and asserts that "all the ♀s bred or captured in June are abundautly prolific" in spite of the fact that he notes Doubleday as "breeding a barren ♀ that had been more than 12 months in the pupal stage." He further asserts (*op. cit.*, p. 297) that all "the autumnal-emerging moths are barren ♀s, *i.e.*, neither ♂s nor egg-laying ♀s," but this is incorrect, many ♂s appearing among the autnmnal imagines (*Ent.*, ii., pp. 305, 325; iii., p. 42, etc.), whilst Andrews gives (*Ent.*, iii., p. 2) a detailed description of an autumnal-emerging ♂, that had quite "normal genital organs, the bulb-like testes being full of active spermatozoa." Other faulty observers have stated

he asserts that it is quite certain that they need some food other than honey to allow them to develop their eggs satisfactorily. The mode of pairing, he says, is most peculiar; instead of the ♀ hanging herself up to call, she flies wildly about, squeaking frequently,* and the ♂, taking hold of the ♀ whilst still on the wing, has paired almost before she has time to alight, nor does the ♂ turn round and stand head downwards when they have paired, as do the other Sphingids, but clings to the ♀ quite differently from any other Sphingid known to him. It is generally supposed that the abdominal scent-fans, found in the ♂, form a sexual attraction, and Swinton observes (*Ent. Mo. Mag.*, xiii., p. 219) that the yellow fan or fascicle of hairs, rising perpendicularly from a fold on either side of the anterior part of the abdomen of the ♂, emits a pungent smell of jessamine, whilst Hall states that the odour is like musk (*Ent.*, xvi., p. 14). Bertkau states (*Verh. d. nat. Ver. Rhein.*, xli., p. 344) that the bristles, forming the brush-like tuft, are connected with glands, which, when the hairs are in an erected position, pour out their contents into the tuft, and thus diffuse the scent. WING-EXPANSION: Moss gives details of the wing-expansion† of the imago as follows: A ♀ emerged between 12.0 (midnight) and 12.15, the wings began to expand at 12.30, the moth remaining fixed in position, though actively twitching the body, contracting and extending the last 4 segments of the abdomen, the ventral surface of segments 9 and 11 especially appearing to contain a volume of fluid in constant agitation. The thorax and other parts of the body at the time are decidedly moist, the hair appearing matted, the antennæ erect, the palpi widely open, the proboscis from time to time extended; the wings were thrown back at 12.55, and were fully expanded at 1.10 a.m., whilst they were finally let down into their normal position (roofwise) at 2.15 a.m. Morres warns those who breed the moth to give them something on which to climb when newly-emerged, and to see that they have sufficient room for the wings to expand, since the wings of necessity hang in a perpendicular position whilst expansion takes place, the tips being curled until growth is quite completed; he says that, after the wings are dry, they gradually separate until, when they are about 1½ inches apart, the whole insect quivers and they suddenly fall back roofwise, entirely covering

that the autumnal-emerging ♀s are not only barren but have no, or an imperfectly-formed, ovipositor, and Aigner-Abafi repeats (*Illus. Zeits. für Ent.*, iv., p. 211) this statement, on the authority of Biedermann (*Soc. Ent.*, iv., p. 105). It has also been asserted that the autumnal ♀s become more sterile the further north they are bred (*teste* Ochsenheimer, *Die Schmett.*, ii., p. 239), although (*teste* Pabst) sterile ♀s are frequently found in Spain. It must not be overlooked that the ♀s referred to by Head (*suprà*) emerged in July.

* As bearing out this view, Anderson writes (*Ent.*, xix., p. 249) that, on August 3rd, 1886, two moths were in the cage together, and that no sooner had he caught hold of one than it commenced squeaking out its protestations, when its companion crawled on his fingers, and could only with difficulty be disengaged. He adds that he thinks that the cry is used as a means of communication between the insects.

† Stephens asserts (*Illus.*, i., p. 117) that, upon emergence, the wings and limbs of the imago are enveloped in a fine thin membrane, which, rapidly drying and opening, liberates the imago, whose wings become speedily enlarged, &c. It is difficult to guess how this strange statement originated.

the body; the imago, he adds, rests in this position until the next evening, when it partially opens and vibrates its wings with a rapid tremulous motion for some seconds, and then suddenly launches itself into the air with a strong and rapid flight. Mrs. Cowl says (*Ent. Rec.*, xiii., p. 155) that various specimens that she had under observation, took from 40 minutes to 2 hours from the time that the wings began to expand until they were put down to rest, *e.g.*, one specimen began to expand its wings at 10.35 p.m., they seemed fully grown at 11.5 p.m., but were not put down till 11.35 p.m., etc. Each imago watched, she says, rested with the two lower legs crossed, after the first few minutes, till it closed its wings, when it used the six. TIME OF EMERGENCE: Mathew and others have observed that the imagines generally emerge towards night. Verloren says (*Tr. Ent. Soc. Lond.*, (3), i., p. 63): "Schröter states that 16 specimens left the pupæ between 4 p.m. and 7 p.m. in the evening, which has been proved by experiments of my own." Groves adds (*loc. cit.*, p. 69) a table of results from 14 bred in 1858, kept in a warm place under a bell-glass, on damp moss, 13 emerging, the last two crippled, *viz.*, ♂, September 1st between 10 p.m. and 8 a.m.; ♂, September 16th, between 10 p.m. and 8 a.m.; ♂, September 16th, at 11 p.m.; ♂, September 17th, at 9 p.m.; ♀, September 21st, time doubtful; ♀, September 23rd, at 11 a.m.; ♀, September 24th, between 6 p.m. and 10 p.m.; ♀, September 24th, between 10 p.m. and 8 a.m.; ♂, September 25th, at 7 a.m.; ♀, October 2nd, ♀ and ♂, October 9th, ♀, October 10th, all between 10 p.m. and 8 a.m. Anderson says (*Ent. Rec.*, vii., p. 86) that the favourite time for emergence is between 7 p.m. and 9 p.m. and after they have been treated to a shower-bath. Livett observes that several he reared all emerged between 9 p.m. and 10 p.m. Mrs. Cowl gives details (*Ent. Rec.*, xiii., p. 155) of emergences as follows: 10.30 p.m., in the night, another in the night, 10.30 p.m., 5.55 p.m., 9.30 p.m., 11.25 p.m., and one at 7 a.m. Burrows, however, notes (*loc. cit.*, p. 156): Of 30 specimens bred in 1900-1, 15 appeared after midnight, *i.e.*, between that and 6 a.m., 1 between 6 a.m. and 7 a.m., 1 at 8 a.m., 1 at noon, 1 at 3 p.m., 1 at 4.30 p.m., 2 at 5.30 p.m., 4 at 9.30 p.m., 2 at 10.40 p.m., 2 not noted=30. They take, he says, at least 2 hours on an average to expand their wings and he leaves them at least 12 hours longer to get thoroughly dry. Glenny records (*loc. cit.*, p. 157) that, of 77 imagines reared in 1900, in no case did a single imago emerge before evening, the usual time being between 10 p.m. and 12 p.m. Russell notes (*Ent. Rec.*, xii., p. 345) rearing 5, all of which emerged in the evening or at night, whilst Edmunds also asserts (*Ent. Wk. Int.*, v., p. 117) that the moths emerge almost without exception during the night; he states that he has allowed them to fly around the room but avers that they were soon satisfied, and would, while still uttering their squeaking notes, hastily retire and settle in some dark part of the room. Burrows confirms (*in litt.*) this, and avers that a high temperature is necessary for natural flight, that, after flight, a dark corner is chosen in which to rest, and that the difference in the behaviour of the moths at high and ordinary temperatures is sufficiently convincing that the moth is not a native. Uhl records (*Ill. Zeits. für Ent.*, iv., pp. 212-213) an imago emerging in June,

1897, at 8 a.m., the wings of which attained their full size in about half-an-hour, but remained hanging down over the insect's back until 10.30 a.m., when they were let down to their normal position. Glenny notes (*Ent. Rec*, xiii., p. 158) that, "immediately on emergence, the imago emits some excrement from its body, and, in several cases, it was noticeable that, where a specimen could not free itself from the pupa-case quickly, and at once discharge the excrement, the specimen was invariably crippled through the apparent lack of power to expand the wings." The imagines, he says, appear never to attempt flight on the same night as they emerge, but remain at rest, when dry, until dusk the next day, when they get on the wing and quickly spoil themselves, if confined in a breeding-cage, by their bird-like flight. VISITS TO FLOWERS: It is generally supposed that the imago does not visit flowers, but Aigner-Abafi asserts (*Ill. Zeits. für Ent.*, iv., p. 213) that, like other Sphingids, the moths suck nectar from flowers, *e.g.*, jasmine, honeysuckle, &c, when flying (*teste* Hufnagel, *Berl. Mag.*, ii., p. 176); he also says that St Bordan took the species at honeysuckle flowers, at Radna and Lippa, and asserts that the supposition, that it does not visit flowers and only flies late at night, is quite erroneous. Still the amount of evidence that it does visit flowers for nectar is very small. Bartel observes (*Pal. Gross-Schmett.*, ii., p. 20) that it flies in the evening and late at night, but more rarely visits flowers (*e.g.*, *Philadelphus* and *Lonicera*) than other Sphingids, comes more freely to the exuding sap of trees, and may be captured at sugar if honey has been added thereto. Caradja also says (*Iris*, viii., p. 62) that it comes to sugar. ATTRACTED BY LIGHT: Réaumur notices (*Mémoires*, ii., p. 296) that, in France, the moths fly into the rooms to light, with great bustle and noise, and Caradja (*Iris*, viii., p. 62) makes a similar observation for Roumania, whilst they have been frequently noted as flying into rooms, &c., by other observers. Hiltbold has taken it at electric light, at Berne, Agassiz at Aix-les-Bains, whilst Bartel also records the moths as being attracted to light. Kerry captured one at electric light at Parkeston, near Harwich, on September 26th, 1883 (*Young Nat.*, v., p. 48); Baxter records (*Ent. Rec.*, ii., p. 253) one attracted to the light of a signal-box, October 8th, 1891, at St. Anne's-on-Sea; Doncaster (*Ent.*, xxxiii., p. 304) on a street lamp in the Strand, October 3rd, 1900; Chope (*Ent.*, xxviii., p. 309) at Colyford, about 8.30 p.m., during rain; Wollstein (*loc. cit.*, p. 310) at electric light, at Kingston-on-Thames; at electric light, at York, October 22nd, 1901 (Hawkins); recorded as being taken at light, at Reigate, September 6th, 1868, by Blackburn (*Ent. Mo. Mag.*, i., p. 130); on a lamp at Bradford, September 17th, 1896 (Carter); at Hackney (Hall), at Mansfield (Daws), at Taunton (Farrant), at Ayton (Whitaker), at Ryde (Moon), at Edinburgh (Burn), whilst one was captured at the entrance-gate leading to the St. Agnes' lighthouse, Scilly, September 14th, 1895, evidently attracted by the light (Frohawk). FLIGHT: Chudleigh says (*Ent.*, xxix., p. 363) that he was surprised at the strength of the flight of the insect, which has a bat-like flittering, and he quite believes that many a specimen on the wing is set down as a bat. We see no reason for Chudleigh's surprise that

M. atropos is a strong flier, for its supposed migrating habits show that it must have a tremendously powerful flight. Bond-Smith notes (*Ent. Rec.*, viii., p. 244) that, on the evening of October 8th, 1896, after a dull cold day, he heard an extraordinary noise in one of his breeding-cages, and found a ♂ and ♀ flying madly about, and believes that they would readily have paired had he given them the chance. Pabst thinks (see *Ent. Rec.*, vi., p. 55) that *M. atropos* exceeds *Hippotion celerio*, *Daphnis nerii* and *Phryxus livornica* in strength and power of endurance, and says that its short tongue enables the insect to feed on exudations from wounded trees, to say nothing of its predatory habits in connection with beehives, so that this species can supply itself with sustenance in this way more readily than its long-tongued allies. MIGRATION HABITS: That the species is a migrant is assumed on much indirect evidence relating to the life-history of the insect in the more northern parts of its range,* and many points favour this view, but we do not know that there is any sound basis for Grote's statement (*Ent. Rec.*, vii., p. 149) that only the ♀s† of this species migrate. Nor is positive evidence wanting. In Loudon's *Magazine Nat. History*, iv., p. 436, is the record of a specimen of *M. atropos* flying on board H.M.S. "Ingate," when on a passage up the Mediterranean, in May, 1831, and some 20 miles off the Spanish coast, Cape Palos being the nearest point. There was little wind, and the observer thinks the species was migrating from choice. Rössler notes two specimens coming on board a steamer off Bilbao, twelve English miles from land, and another taken on a yacht between Gibraltar and Malta. Fletcher writes (*Ent.*, xxxiv., p. 245) that, on June 9th, 1901, he caught a specimen on board ship, when at sea between Sardinia and Majorca, and he thinks that it flew on board the night before when not less than 70 miles from land, whilst again (*in litt.*), on August 24th and 25th, 1901, one was captured each evening, when on passage from Malta to Gibraltar, the specimens having probably come from the Algerian coast which the ship had approached within 8 or 10 miles. Mathew also notes (*Ent.*, xviii., p. 295) that, on August 26th,

* Aigner-Abafi considers (*Illus. Zeits. für Ent.*, iv., p. 212) that the life-history of the species in Hungary is rather against the immigration theory, Pech of Budapest, asserting, that there, the imagines never emerge in the autumn, only in the spring, whilst from late October larvæ he had never obtained imagines, although Aigner-Abafi, himself, has several times bred imagines in October and November, and surmises that all larvæ, not full-grown at the arrival of the first frosts, must perish. All of which, in our opinion, supports the theory of immigration rather than otherwise. Keferstein insists (*loc. cit.*) that a species that can hybernate in any stage in a country must be considered indigenous to it. He accepts Pech's statement (*suprà*), as also that of Scopoli (*Ent. Carn.*, p. 185), *viz.*, larva September 21st, imago June 10th; of Kühn (*Naturforscher*, ix., pp. 93-4) larva autumn, imago first week in May, as well as the statements of Esper, Ochsenheimer and Godart, that the larvæ occur in autumn, the imagines emerging therefrom in autumn or spring, as proving his contention that *M. atropos* is indigenous.

† This idea evidently originated with Pabst (see *Ent. Rec.*, vi., p. 55) who states that "pairing, probably, always takes place at the locality where the moth emerges from the pupa; the more northern captures seem to be always of ♀s urged to their lengthy journeys by the necessity for depositing their eggs. The ♂s seem to be exhausted by the act itself and consequently to perish at their homes." In our opinion much more evidence is wanted to fully, or even satisfactorily, support such a broad generalisation.

1885, two specimens came on board ship when entering the English Channel, whilst, on August 11th of the same year, a specimen came on board when the ship was at anchor off Algiers and some few nights later, between Algiers and Gibraltar, one flew on board and ran squeaking up his leg. To the same observer we are indebted for a most important record (*Ent.*, xxxvi., p. 192) of the capture of a specimen of this insect on the coastguard cruiser "Rose," when in the North Sea, off Southwold, on April 28th, 1903, at 5 p.m., so that it had probably flown on board the previous night; he notes that the weather during the night had been fine and warm with a light breeze from the south-west, and the ship was cruising from 5 to 10 miles off the land. Two other specimens were recorded as captured in Britain, in May, 1903.* Considering the small number of individuals that must come under the ken of lepidopterists, even if a very extensive immigration has taken place, owing to the large area of distribution and the fact that potato-fields and such like localities will be chiefly chosen for settlement †, one is constrained to ask whether these three specimens were examples of an immigrating band. The cold and wet May and June of 1903 must have been against the eggs and larvæ if any resulted. An example, taken by Captain Walker on the s.s. "Kara" off Shanghai, was exhibited at the meeting of the Sth. London Ent. Society, June 14th, 1894, by Manger (*Ent.*, xxvii., p. 248), whilst Fothergill writes (*Ent. Mo. Mag.*, xiv., p. 185) that, in 1877, one flew on board the steamer "Cameroon" on the voyage home from Africa, while off the Cape de Verde Islands. Bates records (*Young Nat.*, v., p. 26) that a specimen was taken on board the s.s. "Horace" when about 25 miles off the coast of Algiers on the evening of August 26th, 1884. Curtis states (*Brit. Ent.*, iv., fo. 147) that there were, in Hatchett's collection, several specimens that came on board a vessel that was lying at anchor off the coast of Devon, about a dozen of them having been knocked down by the sailors. Bennington notes (*Zool.*, p. 1443) the capture of a specimen on May 30th, 1846, at sea off the Casket Rocks, Service records one taken midway between the Isle of Man and Mull of Galloway, and West says (*Ent.*, x., p. 300) that, on October 8th, 1877, an engineer on one of the vessels of the Dublin Steam Packet Co., brought a living *M. atropos* that had alighted on deck, when 25 miles from the Irish coast. (On October 6th, 1876, an example of *Agrius convolvuli* alighted on the same steamer.) Clarke also notes (*in litt.*) that specimens have frequently been taken on the Manx steamers‡, the insects having flown on board, when some distance

* It may be observed that one of these specimens was captured at Ipswich on May 21st, 1903 (Hocking *in litt.*), the other on May 15th, 1903, in a street, at Saltaire (*Ent.*, xxxvi., p. 193). These possibly belonged to the same flight.

† Tuck notes (*Ent. Rec.*, ix., p. 265) that, in 1896, when the larvæ were so abundant, many were found, in the neighbourhood of Bury St. Edmunds, in several cases, in potato-patches that were far away from fields where any potato crop had previously been. The fact that the eggs must be laid on potato-plants, in the spring or early summer of every year in which the larvæ are abundant in autumn, points strongly to immigrant imagines arriving here in May, June, or July—the time of one of the great imaginal emergences in Africa.

‡ This general statement refers to West's record (*suprà*), added to the fact that Clarke saw in a museum at Distington no fewer than 5 specimens of *M. atropos* that had been taken at different times on Manx steamers when sailing between Douglas and the mainland (*in litt.*).

from the coast. Clogg notes (*Ent.*, ii., p. 341) that, in 1865, one was taken on board a schooner in the Bristol Channel, 10 miles from land, and another came on board a fishing-vessel, in the English Channel, when 4 miles from land. Lighton observes (*Ent.*, ii., p. 133, the capture of one on a boat in October, 1864, in the port at Dartmouth. Kerry records (*Ent.*, xii., p. 271) that, in September, 1879, a specimen was caught off the Harwich coast, on the "Cork" lightship, which was moored at the time 7 miles from land; he further notes (*Young Nat.*, iv., p. 23) a specimen captured September 21st, 1882, on board a ship in Harwich harbour. Dillwyn records that, in 1864, the captain of a vessel brought him a specimen of *M. atropos*, which he saw fly, and then settle on the sails of his vessel, when it was several miles from shore, near the mouth of the Bristol Channel. Clarke notes (*Nat.*, 1892, p. 339) that, in October, 1892, a specimen flew into a boat a little distance out at sea off Scarborough. Daws records (*Ent. Rec.*, xi., p. 318) having a specimen brought to him, on September 17th, 1899, that had been taken on a fishing-boat whilst voyaging between Scarborough and Penzance. Kent mentions (*Ent. Wk. Int.*, viii., p. 67) one picked up alive at sea off St. Leonards, on May 23rd, 1860, and Potter (*op. cit.*, vii., p. 27) that a ♀ was captured on board H.M.S. "Minx," when lying in the river off Woolwich, on October 11th, 1859; Backhouse notes one taken off the coast of Northumberland, four miles out at sea, and Hedworth says that two were taken on board a wherry at Dunston, whilst Robson states that, at Hartlepool, when herring-nets are spread out to dry, the insect is occasionally found entangled by its hooked claws . . . It has also been brought to him by herring-fishers flying to the lights of the boat when at sea. He further observes (*Young Nat.*, vi., p. 239) that one was picked up on the beach at Hartlepool, among seaweed, in September, 1885, and also notes (*Young Nat.*, vii., p. 128) a ♀ taken on board one of the fishing-boats off Hartlepool, in 1886, and a second found on the rocks two days later. Esson records one (*Entom.*, xxiii., p. 168) taken by a fisherman at Aberdeen. Frohawk notes (*Ent.*, xxviii., p. 280) a ♂ specimen being washed ashore in a breaker in September, 1895, at Porthcawl, and another (as noted above) taken at the lighthouse of St. Agnes (*loc. cit.*, p. 310), in the Scilly Isles. Beare records (*Ent. Rec.*, xiv., p. 276) a specimen captured on the s.s. "Neiman" on a voyage from Leith to Hamburg, it flew on board when the vessel was about 20 miles east of the May Island, whilst Hill mentions (*Ent. Rec.*, iv., p. 272) a specimen captured on the beach at Seaford on September 28th, 1893. Powell writes (*in litt.*): "The perfect insect is scarce at Hyères, and is rarely met with. I met, however, with a single one, one evening some 8 years ago, out at sea, between the Island of Porquerolles and the mainland, when the insect struck against the sail and fell into the boat; it was in the summer-time but I have no record of the date." ROBBING BEEHIVES: The fact that the imagines of this species rob bee-hives* of the honey stored

* Levoiturie states (*Pet. Nouv. Ent.*, i., p. 354) that *M. atropos* also visits the nests of *Vespa crabro*, but Huber avers that the moths do not frighten wasps when they enter their nests, as they do bees, but that, on the contrary, the wasps soon turn them out in a dying state.

therein has long been asserted, and Aigner-Abafi gives (*Illus. Zeits. für Ent.*, v., pp. 36 *et seq.*) a detailed historical account of the facts relating thereto. Kühn records (*Naturf.*, xvi., p. 73), in 1779, an example entering a bee-hive, at Eisenach, an unusual commotion among the bees, leading to the discovery of the dead bodies of several specimens of *M. atropos* in the hive, and he adds that, several times, dead moths had been found in hives in the same town. He suspects that they had entered in quest of honey, the short tongue and slow heavy flight rendering it difficult for them to extract their food from flowers. Huber,* in 1804 (*Nouvelles Observ.*, ii., pp. xi and 299), and other authors have given details of the habit, and more modern confirmation of the facts is not lacking. Aigner-Abafi states (*Ill. Zeits. für Ent.*, v., pp. 37 *et seq.*) that the imagines, in early September, about 8 p.m., will fly round a hive in concentric circles, that they then force their way into the hive, stay only from two to five minutes, emerge, with the legs and wings frequently covered with bees which are quickly shaken off, the body, however, being often so full of honey that the moth cannot fly (*Bienenzeitung*, 1861, p. 589); sometimes, however, the moth is unable to find its way out, dies in the hive, and is then encased in wax by the bees (*op. cit.*, 1858, p. 214; 1859, p. 33), whilst, occasionally, the bees make the entrance smaller so as to prevent the entrance of the moths. Aigner-Abafi himself, in 1885, near Budapest, caught several moths at an apiary; he says that they flew up rapidly at dusk, circled round the hives, flew off if disturbed, but returned again, that each one entered the hives suddenly, beating off the bees, who, however, frequently kill a weak specimen, that, having filled itself, the moth emerged, remaining a moment at the entrance as if half-dazed, and that, at this time, he made most of his captures. He says that the moth does not utter a squeak on flight, either on entering or leaving the hive, but, whilst it is in the hive, and after one has captured it, it squeaks incessantly. Stephens notes (*Illus. Haust.*, i., p. 118), on the authority of Backhouse, that one was observed at Sunderland buzzing about a bee-hive, and Robson says (*Nat. Hist. Trans. North. and Durham*, xii., p. 38) that "Howse has an interesting example of *M. atropos*, found at Creswell Hall, enclosed in a waxen covering by the bees, to whose stores it had penetrated." At the meeting of the *Ent. Soc. of London*, on May 4th, 1857, Westwood exhibited a skeleton of *M. atropos*, lately found in one of his bee-hives. His attention had recently been drawn to one of his hives, the stock of which did not commence working and gradually got weaker and weaker till at last scarcely 100 bees remained. On turning up the hive he discovered the remains of the *M. atropos* exhibited attached to the comb. Adye notes (*Ent.*, xx., p. 302) the capture of a large ♀ specimen at Christchurch when crawling over a bee-hive. Dalglish records one (*Ann. Scot. Nat. Hist.*, 1900, p. 250) taken off a bee-hive, at Kilmarnock, on July 11th, 1900. Cruttwell observed

* In a discussion in the *Yorkshire Post*, 1900, Boyes denied that *M. atropos* visited bee-hives, stated that Huber was blind and obtained his information secondhand, and suspects that all he wrote was the result of the fertile imagination of his servant François Burnens. It is to be noted that Burnens has always borne the reputation of being an excellent observer.

(*Ent. Mo. Mag.*, xxix., p. 213) a specimen on June 1st, 1893, coming from a bee-hive at Kibworth, covered with bees which were pushing it out of the entrance ; he adds that it squeaked loudly but appeared to be unable to fly. Storer also records one found in a bee-hive at Mountsorrel, near Leicester, whilst Gordon states (*in litt.*) that he found one trying to enter a bee-hive at Quhillart, Corsemalzie, on July 14th, 1898. Bartel notes (*Pal. Gross-Schmett.*, ii., p. 20) that, in Italy, where apiculture flourishes, and *M. atropos* is locally very common, it does great damage by breaking into the hives. We do not know Bartel's authority for this statement (unless it be the *Bienenzeitung*, 1860, p. 108), but, in a German magazine (*Prometheus*, xiii., p. 187), Hermes details at length that, whilst at Rovigno, in September and October, 1901, he saw a hive of bees that had built their cells between a closed blind and window-pane in a house, the structure they had built measuring 40cm. by 40cm. by 15cm. ; the work of the bees could be watched, many cells of the hive were full of honey and sealed with wax, and specimens of *Manduca atropos* got into the hive, through openings in the blind, during twilight and through the night, pilfered the honey, failed to find the opening by which they had entered and were imprisoned. On October 1st, large numbers of imprisoned moths were noticed and Dr. Schaudinus, of the Zoological Station near, removed above 100 specimens, of which 35 were in good enough condition to be set. Daily, after that, 4 or 5 were captured, and in the daytime they appeared to be much disturbed by the bees ; after the 13th, none appeared for a time but two were taken as late as November 1st, 154 specimens altogether being captured. Nearly as interesting is Miss Barrett's record (*Ent. Mo. Mag.*, xxxvi., p. 141) that a specimen of *M. atropos* was attacked by bees when attempting to get into the comb high among the rafters in her house at Buntingville, Transkei, in South Africa, and she further remarks that, whilst the bees were attempting to sting it, it uttered its well-known cry ; a second was caught at a bees' nest in the other wing of the house, but this had settled quietly where the honey sometimes runs down the wall ; more examples were found later, always at or near the bees' nests, those found by day settled quietly in the window-frame with the bees buzzing round in a rage, whilst one was found at night, by searching with a light, settled under the bees' nest. This lady had previously stated (*loc. cit.*, xxxiv., p. 240) that the species was in ill-repute with bee-keepers in South Africa, but Campbell appears to have been the first to call attention to the visits of the moths to beehives in South Africa ("Travels in South Africa," *Quarterly Review*, 1815, p. 315). Rickard thinks (*Ent.*, xxx., p. 24) that the reason why imagines are so rarely found in bee-hives in England is to be found in the construction of the hives. Atmore says (*Ent. Rec.*, ix., p. 23) that a large battered imago was given him on July 18th, 1896, by a friend, whose bees it had alarmed by entering one of the hives ; the swarm appears to have been a weak one and the moth put the bees to flight. Corbett notes (*Nat.*, 1901, p. 255) an imago, found in a bee-hive on June 7th, 1901, at Blaxton. Britten records (*Ent. Rec.*, xiv., p. 163) the capture of

a fine imago at Little Salkeld, on June 1st, 1899, at a bee-hive. In Pabst's account of this species, there is a note by the editor (Krancher) in which he states that he has long given attention to this species on account of its propensity for entering hives, and because, especially in places where it is common—Hungary, Italy, &c.—it is in a position to ruin whole apiaries. He then refers to a long article that he wrote on the subject in the "Deutscher Bienenfreund," 1889, nos. 17, 18, and 19. Perkins notes (*Ent. Mo. Mag.*, xix., p. 236) that a ♀ specimen was caught in May, 1861, by Lloyd, at Badminton, flying in the open daylight in front of his hives, and apparently trying to enter one of them. Hellins records (*Ent. Mo. Mag.*, xxiii., p. 162) that, on July 28th, 1886, at Dartington, a peculiar noise was heard at the beehives as if something was disturbing the bees; the intruder was discovered to be a specimen of *M. atropos* covered with bees, squealing, and that it could not, or did not, fly; the moth was captured and kept for a fortnight before it died. Hawker records (*Ent. Wk. Int.*, vii., p. 43) an imago hovering at dusk, about beehives, and being attracted into a room at Horndean by a plate of honey; Hopson notes a ♀ found at Abbotsbury, wedged in the entrance to an old-fashioned skep beehive, considerably damaged, apparently by the bees; Bell-Marley mentions (*Ent.*, xxx., p. 122) that imagines were reported to have paid some beehives, at Tenbury, several visits in July and August, 1896. Cry of the imago: Of the cry of the imago, which was compared by Esper with the chirp of *Polichylla fullo*, Scop., by Hufnagel with the noise made by the Cerambycids which rub the hard dorsal plate against the elytra, by Kühn with the squeak of the "Spitzmaus," by Rössler with that of the ordinary mouse, and by Nicholson (*Ent. Rec.*, vii., p. 120) with that of the cry of the corncrake, but repeated incessantly instead of twice at short intervals, as in the case of the bird, much has been written *. Réaumur writes (*Mémoires*, ii., pp. 291 *et seq.*): "De tous les insectes, il est celui qui seroit le plus propre à faire prendre son cri pour une véritable voix; car le cri paroît partir du même endroit d'où partent ces sortes de sons. La trompe est, à proprement parler, la bouche du papillon; la trompe de celui-ci est épaisse, et assés courte, elle forme au plus deux tours de spirale; elle est logée entre deux barbes, entre deux tiges barbues. C'est de l'endroit où est placée la trompe, que sort le cri; c'est de quoi il m'a été aisé de m'assurer; il me l'a été en même temps de reconnoître qu'il étoit produit par les frottemens des tiges barbues (pl. xxiv., fig. 7*b-b*) contre la trompe. Chacune d'elles est un cordon plus large qu'épais, une espéce de lame qui se termine par un pédicule dont l'insertion et l'attache sont dans le dessous de la

* Any theory hazarded as to the cause of the sound must take into account the fact that it can be made by the moth in the pupa (see *anteà*, p. 432). Quite recently St. Bordan observed (*Rovartani Lapok*, iv., p. 179) that the sound from an enclosed moth was audible 5 or 6 days before the moth emerged. Aigner-Abafi observes (*Illus. Zeits. für Ent.*, iv., p. 356) that the fact that the moth when in the pupa-case can make a noise exactly like the imago, where there can be no in-and-out movement of the air is convincing that the sound is not caused thereby but by the friction of the two halves of the tongue. Edwards asserts (*Ent. Wk. Int.*, v., p. 117) that he heard the same kind of sound as that made by the imago, though fainter, from a pupa that had not acquired much of the dark hue, which is rather astonishing.

tête. Ces lames sont posées de chan; la courbure d'un de leurs côtés est telle que ce côté s'applique exactement contre la tête le long de laquelle la lame s'éleve; ainsi, ce côté qui est, à proprement parler, l'intérieur est concave, pendant que le côté extérieur est convexe. Ces lames font deux cloisons, entre lesquelles la trompe est logée; elles sont exactement appliquées contre la tête, mais ce n'est qu'à leur origine qu'elles lui sont adhérentes. Un des bouts du rouleau formé par la trompe, est touché par une de ces cloisons, et l'autre l'est par l'autre. Pendant que je tenois le papillon assujetti, pendant qu'il crioit le plus fort qu'il lui étoit possible, j'ai passé une épingle dans le centre du rouleau, j'ai étendu la trompe (pl. xxiv., fig. 6*t*). Quand la trompe a été bien étendue, quand elle n'a plus été entre les cloisons barbues, le papillon a été entiérement muet, il n'a pas fait entendre le moindre cri. J'ai ensuite abandonné la trompe à elle-même; elle s'est roulée sur-le-champ, le rouleau s'est logé entre les barbes, et sur-le-champ la voix et la forte voix est revenue au papillon. Pour m'assurer plus positivement que ce n'étoit pas de la trompe que ce bruit partoit (car roulé, elle en auroit pû faire un qu'elle ne faisoit pas étant étendue); j'ai passé l'épingle sous les deux bouts supérieurs des cloisons barbues, c'est-à-dire, entre ces cloisons et la tête (pl. xxiv., fig. 7*b-b*); en éloignant ensuite l'épingle de la tête, je tirois les deux barbes en-devant, je les éloignois de la trompe, je mettois à découvert les deux bouts de son rouleau. Quand donc les bouts de la trompe n'étoient plus ni cachés, ni touchés par les cloisons barbues, le papillon ne faisoit plus entendre de cri. Enfin j'ai écarté de la téte une seule cloison, et j'ai laissé l'autre en place, je n'ai découvert qu'un bout de la trompe; le cri alors a continué, mais il a été plus foible, moins fourni. Il est donc certain que c'est et de la trompe et des deux barbes entre lesquelles elle est, que dépend le cri de ce papillon, et, dès qu'on sçait que cela doit être, on voit en partie comment cela est; on est attentif à observer les barbes, et on remarque que, pendant que le papillon crie, elles ont chacune des mouvemens assés prompts qui les éloignent un peu, et qui les rapprochent alternativement du rouleau. Elles se meuvent parallélement à elles-mêmes en avançant vers le milieu de la tête, et ensuite en s'en écartant un peu. Voilà les mouvemens nécessaires pour produire les frottemens d'où naît le cri. Le vrai est néanmoins, que j'ai inutilement tenté de frotter une épingle contre un des bouts du rouleau de la trompe, je ne suis point parvenu à produire de cri; mais apparemment que le papillon ménage mieux les frottemens que je n'ai sçu les ménager. J'aurois été disposé à croire que l'air, pour produire ce bruit, demandoit à être renfermé entre les cloisons et la trompe, si le bruit ne se fût pas fait entendre lorsque je tenois une des lames éloignée de la trompe. Au-dessous de la trompe à son origine, il y a une membrane tendue qui peut bien avoir part au bruit. Je ne me lasserai point de répéter que nous devons nous attendre que, dans les plus petits sujets, il restera toujours quelque chose que nous ignorerons. La membrane dont nous venons de parler, paroît percée, au-dessous de la trompe, de deux trous dont l'usage m'est absolument inconnu. La trompe de notre papillon à tête de mort, n'est pas faite comme les trompes longues et plates par lesquelles passe le suc nourricier, et par lesquelles

le papillon respire l'air. Ces grosses trompes ne serviroient elles que de conduit au suc des plantes, les deux trous donneroient-ils entrée ou sortie à l'air dans le corps du papillon?" Réaumur's view appears to have been accepted without question by Linné, De Geer, Schröter, and others of our earlier writers, but afterwards much discussion took place and very different theories as to the cause of the sound were formulated. As bearing on Réaumur's view we may here note that Duponchel, at one time, considered (*Ann. Soc. Ent. Fr.*, 1839, p. 59) that the sound was due to the rubbing together of the prothorax and scutellum, Guérin (*op. cit.*, 1838, p. lv) and Landois (*Zeits. f. wiss. Zool.*, 1848, p. 55) were of opinion that the rubbing of the maxillæ and palpi produced the sound, Van der Hoeven held (*Tijds. Ent. Ned.*, ii., pp. 117 *et seq.*) the same view with the modification that the roughnesses at the base of the tongue rubbed against one another, Rösel considered that it arose from the rubbing of the thorax and abdomen, and Vallot (*L'Institut*, ii., p. 7) that the sound arose from the movement of the wings. Nerland, however, pointed out (*Insecta*, iii., p. 87) that the moth could stridulate when quite still and without any external movement being observable, whilst Kirby and Spence further note (*Introd. to Entom.*, 7th ed., p. 493) that, when the wings as well as the thorax and abdomen are held down, the cry becomes still louder. Layard opines (Tennent's *Natural History of Ceylon*, p. 427) that the sound made by *M. satanas* is caused by air being passed through the stigmata of the 1st abdominal segment, which, streaming out, he supposed set in motion the strong tufts of bristles which cover the opening. Lorey earlier advocated (Godart's *Hist. Nat. de France*, iii., p. 18) this view, but various observers have pointed out that these abdominal tufts are merely ♂ secondary sexual characters and not connected with the stigmata. Goureau states (*Ann. Soc. Ent. Fr.*, 1837, pp. 66 *et seq.*) that the sound appears to proceed from a fold towards the base of the abdomen, and later (*loc. cit.*, 1840, pp. 125-128) it does not seem, he says, to be produced by any special vocal organ, but appears to be analogous with the humming sound made by diptera and hymenoptera, which is produced by the vibrations of the thorax, set in motion by the powerful muscles which it contains. Tremeau de Rochebrune in his article (*Actes Soc. Linn. Bordeaux*, v., 17, 120, 122, 1832) on the cry of *M. atropos*, begins by mentioning that Réaumur attributed it to the friction of the proboscis against the palpi, Lorey to the air escaping through the tracheæ which exist on either side of the abdomen, while Passerini regarded it as arising from the interior of the head, that is to say from a cavity which communicates with the "faux-conduit" of the tongue, where are placed some muscles which are alternately lowered and raised in such wise that the former movement makes the air enter this cavity whilst the latter expels it. Rochebrune's own experiments led him to a different conclusion from any of these. His experiments may be summarised as follows:

1. He extended the tongue so that it could not touch the palpi, and the cry continued.
2. He carefully closed the tracheæ with soft wax, yet the cry continued unabated.

3. He ran a pin into the head and underneath the tongue of another specimen, when the cry ceased suddenly.

4. After having removed the sinciput of another living specimen, he saw the play of the muscles which rose and fell at each cry. He paralysed these with a sharp instrument; the cry ceased immediately. The interior of the head presents, he says, on each side, two small corneous bodies, transparent, elongated in form, having at the middle of their length a strong ridge on the convex part.

5. A pupa of *M. atropos*, which he took from the earth some moments before the emergence of the imago, having uttered a rather faint little cry when he pressed it between his fingers, he considered that this cry could neither be produced by the friction of the tongue against the palpi (on account of their position in the pupa) nor by the escape of air through the tracheæ, nor in the way suggested by Passerini, but by the action of the muscles on these two corneous bodies of which he has spoken.

The cry, he says, does not appear to him to be produced by air driven from the interior of the head, because the tongue, rolled up against it, leaves, in this position, very little or no passage for the air. He suggests that the corneous bodies, which are found in the interior and at the two sides of the head of this species, may be a character of the male, like the stridulating organs in the males of orthoptera, and proposes to investigate this point further. [He adds that the larva of *M. atropos*, when irritated, utters a slight cry which he thinks comes from the head and not from the friction of the mandibles one against the other, as might have been thought, for the cry did not cease when he had removed the mandibles.] Aigner-Abafi asserts that Goeze observed that there must be an internal vocal organ, a view which, half-a-century later, Passerini (already referred to *suprà*) supported (*Ann. Sci. Nat.*, 1828, p. 332), asserting that there is a hollow in the head connected with the false canal of the palpi, whilst a long and excellent note (based on personal experiments) by Ghiliani (*Bull. Soc. Ent. Fr.*, 1844, pp. lxxii-lxxiv) seems completely to support Passerini. Reference should also be made to the details given by Goureau (*Ann. Soc. Ent. Fr.*, 1883, pp. 401, *et seq.*), and Duponchel (*op. cit.*, 1839, pp. 59-65), some of whose earlier views ran in this direction. Rossi, too, who at first adopted Réaumur's explanation, later came (*Opusc. Scelti*, v, p. 173) to the conclusion that the sound was produced by air being forced through the trunk. Nordmann (*Bull. Acad. Imp. Sci. St. Petersb.*, iii., pp. 164-168), as the result of his own investigation of the anatomy of *M. atropos*, says that he entirely failed to find the cavity connected with the tongue which Passerini mentioned. The true cavity of the tongue, he says, leads into the œsophagus and then into the venter. He contends that if Passerini's observation had any foundation, then the respiratory organs in this moth must be double. His own view is that "the organ, by the aid of which the death's-head moth produces its oft-mentioned loud piping sound, has its seat, neither in the head nor in the tongue, but on the underneath part of the abdomen." He says that "on the first abdominal segment, below the first spiracle, lies a fold, perhaps 4 lines in length, broader above, gradually narrowing below, which is formed from the less projecting margin of the first segment and the more projecting of the second; this cleft or recess, when artificially extended, measures, at its greatest width, nearly half a line, and is covered by a long, narrow, oval, white membrane, a tympanum, which

seems to have a notch or incision opposite the first segmental incision; the inner side of the membrane—that which is turned towards the cleft—is quite naked, the outer side or surface, with the exception only of a part of the margin, being clothed with the fur which covers the entire body of the moth; the inner hollow of the cleft is clothed, as part of the general surface of the body, with an extremely fine, white, naked, and elastic skin, and functions, on the passage of the air out of the spiracle, as a resonating body when the vibrations of the tympanum are communicated thereto. When the moth is not disturbed, and respiration is going on normally, there is a large tuft of long yellow hairs lying close beside one another in the cleft covered by the tympanum, but, when it is excited, the more violent passage of the air from the spiracle, and the muscles of the abdominal segments extending the cleft, cause the hairs to become erected, and they now form—bristling and trembling on account of the stream of air which is passing out—two funnel-shaped tufts projecting far beyond the upper surface of the segment. At the same time, the tympanum, which is also extended, begins to vibrate and the shrill cry is produced." He concludes that the vocal apparatus of *M. atropos* is, therefore, near that of *Tettigonia*, and nothing so unique as had hitherto been supposed. We have quoted this in full as characteristic of the details given by those observers who have mistaken the ♂ abdominal tufts for the sound-producing apparatus. Johnson asserts (*Ent.*, ii., p. 325) that the imago of *M. atropos* makes its noise "by respiration through an aperture under the superior wing, &c.," *i.e.*, through the cavity in which the ♂ tufts lie. This statement was contradicted by Taylor (*loc. cit.*, iii., p. 3) who pointed out that the ♀ squeaks as loudly as the ♂, although she has no such apertures. He himself thinks that "the sound is caused by the forcible passage of air through the spiracles." Burmeister hesitates to accept (*Handbuch der Entom.*, i., p. 514) Passerini's conclusions, unless there is a vibrating membrane at the entrance where the air was supposed to leave the head, but adds that Duponchel has stated that a fine membrane exists between the eyes and base of the tongue which might be set in vibration by the ingoing and outgoing air; at the same time, Burmeister believed that the sound originated in the head. Russell states (*Ent. Rec.*, xii., p. 345) that the noise appeared to him to be produced by a movement of the joints or some of the joints of the legs. Preston believes (*Ent.*, iii., p. 4) that the sound is caused by the movement of a very strong muscle and states that he was able to produce the sound artificially by moving the same. Newman also states (*loc. cit.*) that this is his opinion of its origin. Sandlin observes (*Ent.*, xxiv., p. 297) that he heard the sound when he moved the thorax of a specimen that he was setting. Anderson reverts to Réaumur's idea, and has no doubt (*Ent.*, xix., p. 249) that the sound is caused by the proboscis rubbing against the palpi, though he believes that the friction of some parts of the thorax may have somewhat to do with it, although, as soon as the proboscis is held down, the squeaking ceases. Paris, who states that the cry of the imago is like that made by the larva, but lighter and sharper, describes (*Bull. Soc. Ent*

Fr., (2), 1846, p. cxii) at length, experiments to show the origin of the sound made by the imago and concludes that it is produced "dans la spiritrompe par une mucosité que l'insecte aspire et foule alternativement à l'aide de ses palpes et des muscles de la tête." It now becomes necessary to refer to those observers who have, as it were, followed up the idea of Rossi and Passerini, the latter of whom, as early as 1828, in an excellent monograph (*Osservazioni sopra la Sphinx atropos*, etc., Pisa, 1828), clearly and correctly explained the whole matter, *viz.*, that the cavity in the head, alternately opened and closed by strong muscles, and opening externally by means of a narrow transverse aperture, is the source of the sound. Westmaas fully adopts (*Tijds. Ent. Ned.*, 1859, p. 131; 1860, p. 120) this view, and criticises especially the statement of Wagner, who asserted that the air cavity was in the abdomen and described (Müller's *Arch. f. Phys*. 1836, pp. 60-62) a relatively large sucking-bladder filled with air, opening directly before the so-called stomach into the food canal, and filling the entire upper part of the body; he considered the sound to be due to the inspiration and expiration of air to and from this sucking-bladder through the tongue, considering it possible that that portion of the air, which passed through the narrow aperture arising from the imperfect closure of the two parts of the tongue, may give rise to the sound. This is practically the later view of Landois, who writes in his "Tierstimmen": "The moth possesses in the front part of the abdomen, close before the true belly, a 'saugblase' [sucking-bladder], which is tensely filled with air, and opens out into the end of the food-channel, through which it stands in connection with the mouth; as the two halves of the proboscis, which are inbent towards one another, do not entirely close together at the front surface, a fine groove or cleft is formed in the middle of the upper side of the proboscis, which (cleft) leads into the mouth immediately below the upper lip; this groove or cleft is very securely and "airtightly" surrounded by the horny upper part of the proboscis, and, in consequence of this arrangement, there originates a small sound-orifice formed by the groove of the proboscis and the upper lip." He states that, "even if only a small amount of air be driven by the disturbed moth out of the pressed-together 'saugblase' through this opening, there arises the well-known half-piping and half-chirping sound. He states that the proof of the correctness of this view is as follows: If one presses on the front part of the abdomen, the moth remains unable, so long as the pressure lasts, to produce the sound, and the like is the case if one in any way stops up the sound-orifice, or forms further a horizontal side-orifice. The sound leaves off as soon as one injures or destroys any organ important to its production, *e.g.*, the extremely small upper lip." Landois further states that it is possible to force air into the freshly-dead moth by way of the tongue, when the body will swell out and the sound* be continued so

* As tending to discredit this view, Aigner-Abafi states (*Ill. Zeits. für Ent.*, iv., p. 338) that half-a-spoonful of honey has been forced from the body of a moth that had been killed by having its head cut off, the head, after separation from the body, squeaking vivaciously. We do not know where this statement was originally made. It may have originated with Taschenberg (*posteà* p. 450, footnoote), although there is nothing said as to the cutting off of the head. At any rate, the actual food-crop is not the air-cavity implicated in the production of the sound, for, as we understand the matter, this air-cavity of the head is separate from the alimentary canal,

long as one presses out the air, the sound, however, ceasing as soon as one cuts off the tongue or separates its two parts. It may be stated that H. Redlich, in his interesting investigation of this phenomenon (*Ent. Zeit. Guben*, iii., pp. 130-131 1890), has, by experiment, established that the part of the proboscis outside the mouth has no share in the production of the noise. Maillard says (*Tijds. v. Ent.*, 1862, p. 20) that an incision made between the eyes of a living moth discloses a cavity (formed by the expansion of the food-canal), which occupies the greater part of the head-space, and that widens and contracts, whilst the insertion of the tongue forms the crop into an upturned flap which is set in vibration by the in-passing and out-passing air. Moseley confirms* (*Nature*, vi., pp. 151-153), in an excellent paper, the theory of Passerini, and gives a diagram and description of the head-cavity and its muscles. Chapman, quite independently of Moseley's experiments, came to the same conclusion as to the source of the sound (see *Ent. Rec.*, vol. xiii., p. 127). He writes: "Material being available I thought it well to investigate the subject for myself. The specimens, having come by post, did not cry so freely as might be desired, and gave an undue importance to anatomy over experiment. It was plain that the noise appeared to come from, or from near, the head; the friction of proboscis and palpi had nothing to do with it, as they could be held apart without affecting it. The only movement associated with the noise was one of the under-surface of the base of the abdomen; a similar movement, as an ordinary respiratory one, occurred without any noise being produced. I made search, however, amongst the air-sacs and dilated tracheæ of the thorax and abdomen without finding anything to produce a sound. I then examined the spiracles which have a very beautiful double valve of lacelike structure as an outward protection, but could find nothing to suggest the prothoracic spiracle as a squeaking organ, nor could I find anywhere a stridulating surface. The corrugations of the proboscis and palpi are rounded, and do not touch each other, confirming the experimental proof that there is no stridulation here. A strained extension of the proboscis did not stop the sound, but distinctly altered the note, rendering it certain that the source of the sound was affected by the altered position. The opposed edges of the two halves of the proboscis are firmly held together, and no friction here causes the sound. In the interior of the head, facing the lumen of the proboscis, is an opening, capable of varying its form from nearly circular to a narrow slit; this opens behind into a cavity of a diameter of about 2mm., lying immediately behind the clypeal region. This cavity has walls of fairly fixed position, being conditioned, below and laterally, by the surrounding chitinous structures of the head, but above it is not in contact with the walls of the

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into which it simply opens near the base of the trunk. We may further note here Passerini's experiment in which the abdomen was separated from the thorax, the moth continuing to squeak, in spite of the mutilation.

* This author gives by far the best account of the real cause of the sound that has been published. We were unfortunate in not being able to refer to it until our own summary had been completed.

frons and vertex. The space here between the frons and this special sac cavity is occupied by a *rete mirabile* of tracheal tubes and over this area the roof of the sac is soft and flaccid, and capable of considerable movement, so much as to amount probably to complete collapse of the cavity when it is depressed. This cavity appeared to be a dilated upper end of the œsophagus, its structure appearing to be continuous with the œsophagus, but I did not succeed in passing a bristle from the cavity into the œsophagus. The primary function of this cavity seemed probably to be to produce a sucking vacuum at the base of the proboscis to draw up honey or other fluids *, its method of action being the alternate turgescence and exhaustion of the tracheal spaces above and also around it, produced probably by the abdominal movements, and utilised by the valvular action of its openings. It seemed to me that air, either drawn into or expelled from this sac through the valvular opening at the base of the proboscis, was the cause of the cry. I entirely failed, however, to obtain a view of this opening or chink during vocalisation and so am unable to feel absolutely sure that this is really a vocal organ. That my conclusion, however, is the same as Mr. Moseley's and was reached without the prompting of previous information gives his view strong support." Poulton is said (*Ent. Rec.*, xii., p. 350) to have asserted that, with a stethoscope (for both ears) ending in a fine tube, he was able to locate the sound, and that, when the tube is placed against the part whence the cry comes, one is deafened by sound, whilst everywhere else over the body it is very faint. His detailed conclusions agree with those of Moseley. Ullyett notes (*Ent. Mo. Mag.*, v., p. 171) that a specimen of *M. atropos*, found in Folkestone Warren in September, 1868, was kept for a few days and until it died a natural death. It frequently emitted the sound peculiar to its species, always raising the thorax and bending down the head and abdomen as it did so. When breathing its last, it gave out a long succession of sounds, growing fainter and fainter, just like a succession of breathings, giving one the impression that the noise was produced not by friction, but by inspiration and respiration of air. Ullyett says that it made the noise when he first had the moth every time he merely touched it with his finger, but when it got accustomed to such treatment it never made it without rather rougher handling. Swinton also asserts (*Ent. Mo. Mag.*, xiii., p. 219) that, when the insect squeaks, the two large air-vesicles at the anterior part of the abdomen are generally inflated by an unusual spasmodic compression of the posterior segments beneath, and that the yellow fan or fascicle of hairs, rising perpendicularly from a fold at either side, emits a pungent scent of jessamine and expands to a stellate form. This action led to the theories of Lorey and Nordmann, already noted, whilst its appearance seems also to have led Wagner to conceive that air was then forced into the cleft haustellum. This particular has a new value now that we have Head's note (*antea* pp. 435-436) as to the mode of copulation, and there would appear to be no doubt that the cry is utilised by the sexes to attract each other, that, in nature, it is used when the

* Taschenberg is reported to have stated that he found a specimen of *M. atropos* in a beehive, which squeaked quite loudly and distinctly, although its "sucking-bladder" was full of honey instead of air.

moth is excited or when the sexual instinct has been aroused, and that the intimate connection that Swinton states to exist between the squeaking and the diffusion of scent by the ♂ (an undoubted sexual attraction), points to the cry being used in nature in order to indicate the whereabouts of the caller, a very necessary detail, probably, in the case of large insects which are possibly in the imaginal state never exceedingly abundant, and may be more or less isolated over a large area of country. The other imaginal movements said by Swinton to accompany the making of the sound, such as elevating the abdomen, depressing the wings, and throwing back the antennæ, are all more or less generally common in certain lepidoptera when under the influence of sexual excitement. In spite of these more recent (and in our opinion conclusive) experiments, Aigner-Abafi (*Illus. Zeits. für Ent.*, iv., p. 355) quotes Dugès view (*Physiologie comparée*, ii., p 226) that the origin of the sound is due to the rubbing together of the opposite halves of the maxillæ, and this Aigner-Abafi asserts is the true explanation. He insists that the sound comes from the mouth, not in consequence of air passing in and out, but by the rubbing together of the two halves of the tongue which are so constructed that each has a concave and a convex fold which, united, completely close the tongue, and thereby made it suitable for sucking up its food; the chitin of the groove is, he avers, quite smooth and the rubbing together of the two surfaces generates the sound, and this occurs only when the moth is disturbed or excited. We now add Swinton's summary (evidently compiled from Moseley's (*Nature*) article) of the literature relating to the subject (*Ent. Mo. Mag.*, xiii., p. 217). This reads as follows: Réaumur says (*Mém.*, ii., pp. 289 *et seq.*) the sound is produced by friction of the haustellum against the palpi; Roesel considers (*Ins.-Belustigung*, iii.,p. 16) that it is due to the friction between the abdomen and thorax; Rossi (*Opuscoli Scelti*, v., pp. 173 *et seq.*) to expiration of air from the haustellum; Schröter (*Der Naturf.*, xxi., pp. 66 *et seq.*) to the friction of the haustellum and head; Engramelle says (*Pap. d'Europe*, iii., pp. 84 *et seq.*) that it proceeds from the "spallette"; and Lorey (Godart's *Hist. Nat. des Lép.*, iii., pp. 18-19) from expiration at the base of the abdomen; Passerini (*Osservazioni sopra la S. atropos*, etc., Pisa, 1828) from the haustellum, caused by expiration from a suction-cavity; Rochebrune's views (*Act. Soc. Linn. Bord.*, v., pp. 120-122) have already been detailed at length; Burmeister (*Handb. der Entomologie*, i., p. 514) asserts that the seat of the voice is in the head; Wagner (Müller's *Archiv für Phys.*, iii., pp. 60-62) thinks that it is due to expiration from the large vesicles at the anterior part of the abdomen through the œsophagus and haustellum; Vallot and Johet (*L'Institut*, ii., p. 7) believe that it is produced by wing percussion; Dugès (*Traité de Physiol. comparée*, ii., p. 226) that it proceeds from the friction of the opposite edges of the two halves of the haustellum, whilst Nordmann reverts to the idea (*Bull. Acad. St. Peters.*, iii., pp. 164 *et seq.*), that the sound is due to expiration of air at the base of the abdomen. Duponchel and Guérin (*Ann. Soc. Ent. France*, viii., pp. 59 *et seq.*) then refute Passerini, and state that the sound arises from the friction of the prothorax on the scutellum, while Goureau (*loc. cit.*, vi., p. 66) asserts that it arises from

a crumpling of the plates forming the integument of the abdomen, but in vol. vii., pp. 401 *et seq.* he retracts and says that the sound comes from the head, whilst in vol. ix., p. 125, he thinks it may be a humming like that made by bees and flies : Abicot (*Bull. Soc. Ent. France*, ser. 2, i., p. 50) refutes Goureau, and Ghiliani (*loc. cit.*, ser. 2, ii., pp. lxxii-lxxiv) confirms Passerini. Paris (*loc. cit.*, ser. 2, iv., p. cxii) ascribes it to a fluid forced up and down inside the haustellum with the assistance of the palpi, whilst Landois (*Zeits. für wissen. Zool.*, xvii., p. 162) originally reverted to Réaumur's view, saying that it is due to the friction of the palpi against the haustellum. Van der Hoeven (*Tijds. Ent. Ned. Ver.*, ii., pp. 117-122) says that it proceeds from friction at the posterior end of the haustellum; Westmaas (*loc. cit.*, iii., pp. 120-124) completely confirms Passerini and confutes Wagner; Capronnier says (*Ann. Soc. Ent. Belg.*, x., C.R., pp. 16-17) that an imago with a deformed head was mute. Newman, Johnson and Taylor (*Ent.*, ii., 1865, pp. 284, 325, &c) repeat the theories of Rösel and Lorey, whilst Moseley (*Nature*, vi., pp. 151-153) confirms the theory of Passerini, and gives a diagram and description of the cavity and its muscles. Swinton himself points out (*E.M.M.*, xiii., p. 218) that authorities are divided as to whether the noise is really due to friction or expiration He details at length Landois' experiment with the palpi, and states that, in good squeakers, he has invariably found a portion of the hair at the outer edge of the basal joint of the palpi worn, and also that the sound of the file may, in some slight measure, be reproduced after the death of the insect by a gentle friction. HYBERNAL HABITS : As an expression of ignorance * we are inclined to agree with Burrows (*Ent. Rec.*, xiii., p. 156) that the species cannot survive even the mildest English winter out-of-doors †. Burrows states (*loc. cit.*) that, in forcing pupæ in October, November and December, a temperature of 60° F. produces the imago in four weeks, one of 70°-80° F. the imago in two weeks, and 90°-100° F. the imago in one week. The higher the temperature the more moisture is required. Carelessness in damping results in the loss of the whole stock. Thus forced, the earliest emergence has been obtained on September 15th, 1893,

* Corbett notes (*Ent. Rec.*, xiii., p. 278) that, for three consecutive years, 1899-1901, *M. atropos* was common in the Doncaster district, and, in the early summer of 1901, an imago captured wild was brought to him, all of which he thinks points to the species having existed naturally in the district for three years.

† Burrows records (*Ent. Rec.*, vi., p. 291) that a pupa of *M. atropos* was dug up in early March, 1895, it was dead, probably killed by the severe winter, and all the tail segments were movable owing to the rottenness of the pupa. Glenny notes (*Ent. Rec.*, xiii., p. 157) that a friend of his, with 82 pupæ in the autumn of 1900, decided to keep them in a cool situation, trying to keep them as nearly as possible so as to imitate their natural surroundings, the result being that every pupa had died by February 20th, 1901. On the other hand, Cambridge obtained 3 pupæ in August, 1900 (*Ent.*, xxxiv., p. 227), kept them exposed in a room supplied with a fire, with the result that one pupa died, a cripple emerged in October, the third emerged perfect, July 11th, 1901. Bowles notes (*Ent. Rec.*, ix., p. 61) that he bred 6 fine imagines of *M. atropos* in November, 1896, but adds that, as soon as the nights got cold, he began to lose the pupæ though the moths were almost matured and ready for emergence; the pupæ appeared to get numbed and feeble; he then put them in a fairly uniform temperature of 80° F., and emergence commenced again. Norgate says (*loc. cit.*, p. 266) that he had an imago emerge on July 26th, 1897, from an 1896 pupa, which had been kept indoors, whilst during the same winter some 9 or 10 pupæ which were left in their puparia, spun in earth in separate flower-pots sunk in the ground and left out-of-doors, all died.

the latest on January 6th, 1901. In 1900, the forcing (60 to 70 pupæ) was conducted at not more than 70° F., the first imago was bred on October 12th, and it was followed by others regularly until November 12th, when about 12 remained, and, as these began to die off, the heat was raised to about 80° F., and four more appeared, the last as stated above, on January 6th, 1901; but so much depends on individual constitution, time at which forcing is begun, the fluctuation of temperature during the process, that little value can be placed on any but the most detailed results. Glenny records (*loc. cit.*, pp. 156 *et seq.*) that, by the end of October, 1900, he had 184 pupæ, that many were injured, but that 62 perfect imagines and 15 cripples resulted, the pupæ being placed on slightly damped moss and kept in boxes on a kitchen mantelpiece, and he thinks that they would force in a temperature of from 60° F. to 70° F., with this slight amount of moisture if it were begun early enough, say in September or October. Bond-Smith, however, points out (*Ent. Rec.*, viii., p. 244) that he had two imagines emerge on the evening of October 8th, 1896, after an exceedingly cold, rough and miserable day, from two pupæ that had only been down 7 weeks, were in quite dry sand, without any moisture, and were in a very cool outhouse. Thorpe observes (*Ent*, v., p. 143) that the larvæ that pupate by the end of August have, with him, generally produced imagines during October, and that a great proportion have been ♂s, whilst those that have remained as pupæ during the winter and emerged in May have generally been ♀s. He bases this generalisation largely on breeding 14 ♀s and 3 ♂s in May, 1870. Anderson's experience (*Ent.*, xi., p. 188) in which he bred 1 ♀ in the autumn of 1877 and 6 ♂s and 1 ♀ in June, 1878, does not support this assertion, although, in a later communication, Anderson notes (*Ent.*, xix., p. 249) that, in the autumn of 1885, he had several pupæ, from which no imago emerged in the autumn, but that 8 appeared between July 20th and August 3rd, 1886, all ♀s. Glenny observes (*Ent. Rec.*, xiii., pp. 157-158) that, of the 62 perfect examples he reared in the autumn and winter of 1900-1, 10 only were ♂s and 52 ♀s. SO-CALLED BARREN ♀s: Verloren claims (*Ent.*, iii., p. 28) to have discovered that the abdomen was empty in the ♀s that emerged in autumn, whilst those that come out in the spring had swollen ovaries. [See, however, Réaumur, *Mémoires*, ii., p. 296.] Newman asserts (*Entom.*, ii., p. 283) that the imagines that emerge in October and November are, with rare exceptions, barren ♀s; the abdomen, he says, is an empty cylinder, containing neither eggs nor ovary, but Doubleday notes (*Zool.*, p. 1862) that this is not always so and instances a ♀ that emerged in the autumn and laid eggs, and also another ♀ bred after being more than 12 months in the pupal stage that was barren. Newman adds that all the ♀s bred or captured in June are abundantly prolific, but we do not know that this is based on actual dissection, and he does not give any evidence in favour of this view nor of the statement that examples that emerge in the winter may live till the following midsummer. In explanation of what he means by "barren ♀s," Newman states (*loc. cit.*, p. 297) that he considers the autumnal imagines "are, with rare exceptions, barren ♀s., *i.e.*, neither ♂s nor fertile ♀s," a most marvellous

and inaccurate statement as far as the ♂ s are concerned. Doubleday states (*loc. cit.*, p. 303) that he bred, on September 16th, 3 specimens, 1 ♂ and 2 ♀ s, both the ♀ s being barren, the abdomina containing nothing but fatty matter just like those of ♂ s. Merrin also notes (*loc. cit.*, p. 325) breeding eggless ♀ s in September, 1865. Bartel says (*Pal. Gross-Schmett.*, ii., p. 4) that the imagines of *M. atropos* (as also all other Sphingid imagines which exceptionally emerge in autumn) have imperfectly-formed sexual organs, and are consequently unfitted for reproduction, and asserts that the continuance of the species is entirely dependent on hybernated pupæ. He states that, according to Kreye and Oudemans, who examined moths bred in spring from hybernated pupæ, the ovipositors of the ♀ s also proved to be undeveloped, and quite unable to produce progeny. The continuance of the species in our latitudes, therefore, he concludes, depends entirely upon immigrants from the south. There is little other proof, we believe, that either the spring- or autumnal-emerging imagines have imperfectly-formed sexual organs. On the other hand, we believe that they are usually absolutely normal. The examples examined by Kreye and Oudemans were possibly quite aberrational. Pabst (from whom Bartel appears to have copied may of his facts), however, makes the same statement; he says that he forced 4 pupæ, that 1 ♂ and 2 ♀ s emerged in December and another ♀ on April 11th following; he asserts that "even the one which was so long in pupa, proved sexually sterile, lacking the normal ovipositor." He says that, both in the north and south, the autumnal broods are infertile, the 2nd brood in the north, the 3rd brood in the south. As bearing on these statements of Newman and Bartel, so far as the reputed absence of ♂ autumnal emergences is concerned, Andrews notes (*Ent.*, iii., p. 2) that he reared an imago in the autumn of 1865, that it was examined by Houghton microscopically to see if it were a ♂, and, if so, whether the genital organs were in any way imperfect, and that he reported: "The specimen is a ♂, and I see nothing abnormal in the structure of the genital organs; the bulb-like testes . . . were full of active spermatozoa." Chudleigh notes (*Ent.*, xxix., p. 363) that he reared a moth on October 5th, 1896, that he "fed it on honeycomb and a doll's saucer of water. As days went by the colours improved wonderfully, the skull and bones became singularly distinct," &c. We do not know how the moth could feed on a "doll's saucer," nor do we suspect that, after the first few hours after emergence, the skull and cross-bones became more distinct than before. In the late autumn of 1900, Bacot kept several moths alive (1) in a warm room (3 days), (2) in a cool room (without fire), he gave them honey in abundance but they refused to feed and only lived a few days (*in litt.*).

TIME OF APPEARANCE.—This is a tropical and subtropical *

* Many continental lepidopterists have agreed that the species has followed the extended cultivated area of the potato in Europe, quite overlooking the fact that the potato itself is an introduced plant, and that the larvæ feed naturally on a host of other indigenous plants (see "Foodplants"). The species is a strong flier, often passing out of its proper range, laying its ova on such foodplants as occur where it happens to be, frequently on potato, because of its general distribution and commonness. The potato, by the nature of its cultivation, provides an abundance of food, and, in suitable seasons, the larvæ thrive, the species only failing to make a permanent home because the late larvæ and pupæ fail to withstand the severity of our late autumn and long winter climate.

species, apparently more or less continuously-brooded in its native haunts †, but, in common with several other Sphingid species, it is a well-known migrant, reaching, in the course of its wanderings north, over the greater part of the Palæarctic area, whilst it extends to the southernmost point of Africa. The allied Asiatic *M. styx*, previously considered a variety of this species, is treated by Jordan and Rothschild (*Revision of Sphingidae*, pp. 21 *et seq.*) as a distinct species. In the Palæarctic area, *M. atropos* appears to be more or less partially triple-brooded in the most suitable seasons, *i.e.*, including the early May-June imagines which are occasionally immigrant here, and which, in hot summers, produce imagines in August and these again in October-November, or, as a continuous brood, from August to November. In other years, the earliest imagines do not appear till July-August, when the only race of home-bred imagines is to be found in October-November, most of the larvæ and pupæ coming to grief unless protected. Under artificial conditions, and when protected, the autumnal pupæ give up their imagines partly the same autumn and partly the next spring and early summer, so that, however short may be the pupal stage in its tropical haunts, such hybernating period as it has belongs to the pupal stage. There seems to be a general opinion on the continent that the July larvæ normally produce imagines in the autumn of the same year, whilst the September-October larvæ go over the winter, *e.g.*, Siépi says (*Feuilles de Jeunes Naturalistes*, 1903) that, "in the Bouches-du-Rhône district, the larvæ that pupate in July emerge in September, those that pupate in September and October, or later, go over until the following June," but there is very little, if any, evidence that pupæ that go over the winter in a state of nature do successfully emerge even in the south of Europe, although records are not wanting that, in confinement, hybernating pupæ successfully produce imagines without artificial heat, and with only the protection of being kept in a room without a fire, *i.e.*, protected against actual frost. Thus we have Rashleigh recording (*Zool.*, ii., p. 473) an imago bred June 23rd, 1844, from a pupa of the preceding year, at Horton Kirby. Goatley tells (*Zool.*, v., p. 1863) of one imago emerging on October 11th, 1846, and another on July 7th, 1847, from pupæ obtained from larvæ that went down at the end of July, 1846; Corbin also records (*Ent.*, vi., p. 520) many larvæ pupating well, all producing imagines in the autumn, except one pupa which lived throughout the winter, and produced an imago in June, whilst Colthrup, from larvæ of September, 1899, taken at Dover, obtained imagines October 7th-18th, 1899, and Howe from pupæ of August, 1899, obtained imagines on September 16th and 18th, 1899, without any forcing. Anderson notes (*Ent.*, xi., p. 188) that, at

† Mathew writes (*in litt.*): "I think that, in the warm parts of the Mediterranean, the species may be continuously-brooded for I have found the larvæ very small in November and December when I have been shooting in Asia Minor. In Britain, all the pupæ that I have ever had, have produced their imagines in autumn, or, if they have attempted to pass the winter in the pupal state, have died before the early summer, and, in 1901, when I kept a number of pupæ out-of-doors in as natural a state as possible, at Dovercourt, all perished. It seems probable, therefore, that ova deposited in spring here are from parents that have crossed the English Channel or North Sea; the build of the moth suggests that it must be a very rapid flier, so that a passage across the sea would occupy only a very short time."

Chichester, he had 10 pupæ in August and September, 1877, and that, without forcing, one emerged in November, another matured at the same time, but died without disclosing the imago, that, by the following April (1878), two pupæ had died and one moth was found dead in the cocoon, the others being then taken into a greenhouse when imagines emerged as follows: June 18th ♂, June 23rd ♂, June 24th ♀, June 25th ♂, June 28th ♂, June 29th ♂, and July 5th ♂. Livett's note (*Ent.*, xix., p. 126) on forcing pupæ, suggests that his would naturally have gone over the winter, for, although forced from October, the moths emerged December 19th, January 7th, February 1st, and March 21st, whilst one other pupa died on March 14th just as the imago was ready for emergence, further, in 1896, the same observer notes that he similarly forced pupæ from September and obtained imagines on November 4th, December 2nd-7th, 1896, and January 1st and 10th, 1896. Cambridge also states (*Ent.*, xxxiv., p. 227) that, of two pupæ obtained from larvæ in August, 1900, and treated similarly (kept in room heated by ordinary fireplace), one emerged in October, 1900, and the other on July 11th, 1901, at Bloxworth; whilst, in 1896, Newnham obtained from 6 pupæ, 5 imagines in October and one on April 17th, 1897, the pupæ being kept in the house and the moss covering them slightly damped. Again, comparing the records from the Marseilles districts with our own records, we find that Siépi notes that, at Marseilles, his earliest capture of the imago wild, has been on June 7th, his latest on September 24th, his earliest bred example appearing on June 6th (from a larva that pupated on October 20th the preceding year), whilst he also bred an imago on August 23rd that pupated at the end of July. Of forced pupæ (kept at a dry heat of 20° C.) he has had them emerge as early as November 14th and as late as April 14th. Powell states (*in litt.*) that the larvæ are found at Hyères in October and November, but that the late examples do not mature; from two larvæ taken nearly fullfed on October 31st and November 1st, 1902, two healthy pupæ, however, resulted, which were kept out-of-doors all winter, exposed to all weathers and all temperatures, and from these two imagines emerged, one on May 30th, 1903, the other on June 3rd, yet, he says, one rarely sees the imago here at large nor has he ever seen the larvæ before September and has taken them quite young in October, so that they can hardly be the progeny of May-June emergences, although he has never himself taken, nor heard of anyone else taking, summer-feeding larvæ, but at Entrevaux, from July 13th, 1903, onwards, he obtained 7 fullgrown larvæ (4 of which were ichneumoned) the 3 others pupating and producing imagines (1 ♂, 2 ♀ s) in August of the same year. Yet, across the Mediterranean, Blackmore found larvæ maturing all through the winter and spring of 1869-70, in Morocco, and spring imagines emerging in due course in March-April. But 170 years ago, the species appears to have occurred in the Paris district much as it occurs with us now, for Réaumur records (*Mémoires*, ii., p. 295) fullfed larvæ, from Nainvilliers on July 16th, 1734, that pupated between July 17th and 24th, the pupæ producing imagines that did not lay eggs, in Paris, between September 5th and October 29th, and adds that, in nature, the imagines are disclosed about the end of September

and commencement of October, but Viret notes that, although the insect occurs generally in September in the Seine-Inférieure, yet it is occasionally captured in April. South of the equator at Durban, 14 larvæ, fullfed in January, 1901, only produced 2 perfect imagines one of which emerged on February 18th, the other on February 25th, the pupal stage having lasted 21 days; in May, 1901, 7 larvæ of the next brood pupated (the last on May 26th) and all emerged in September, two on the 7th, one each on the 9th, 13th, 16th, 19th, and 20th, after a pupal period of 4 months, so that here also the hybernation appears to be a pupal one (Leigh, *Ent.*, xxxiv., p. 348). Our dates show pretty conclusively that the earliest European arrivals (or emergences) vary from year to year (in some years the species is entirely absent in the greater part of Europe), but usually appear to be in May and June, *e.g.*, Mathew records a specimen taken on board a cruiser off Southwold, on April 28th, 1903 (*Ent.*, xxxvi., p. 192), &c. (For other records see *antea* pp. 439 *et seq.*) If the weather be fine on their arrival they lay eggs at once, and larvæ are found in July, imagines in August, larvæ again in August, September, and October, imagines (very few in proportion to the number of larvæ sometimes captured) in September, October, and November. It is from this late brood that most of the forced examples raised in Britain and central Europe are obtained. But many lepidopterists of central and eastern Europe believe that the species is sedentary with them. Fuchs discusses (*Ent. Zeit. Guben*, 1890, no. 10) this point and concludes that it is indigenous in Lower Austria, whilst on the whole, too, Aigner-Abafi thinks (*Illus. Zeit. für Ent.*, iv., p. 212) that the species is sedentary in Hungary, surmising that the species is sufficiently abundant every year in some variable central area where imagines are not uncommon, that the few spring imagines, which are, he asserts, very fruitful, come from these centres, although the great mass of the hybernating pupæ must perish. The fact that imagines have been captured in June, *e.g.*, at Aschaffenburg (*S.E.Z.*, 1887, p. 257), Coblenz (*Ent. Zeit. Guben*, vi., p. 32), Meissen (*Iris*, v., p. 396), appears to us only to support our own view, and not to prove, as Fuchs holds, that the pupæ from which these came wintered where the imagines were found. Pabst appears to hold the view that we ourselves have suggested as that best met by the evidence. He suspects the spring immigrants into Europe to be largely gravid ♀s; he further considers that, in its most southern localities, the species is triple-brooded, imagines appearing (1) at the end of May, (2) at the end of July, and (3) at the end of August and beginning of September, this latter being only a partial brood. He says that, at Vienna (*teste* Fuchs) and at Dresden (*teste* Steinert), the moths do not appear from hybernating pupæ until the end of June, and that their progeny produce imagines that appear partly in autumn and partly not until after the winter, whilst Unzicker, who reared the species from eggs laid by a ♀ found in May, states (*Ent. Zeit. Guben*, 1892, p. 82) that, of the imagines reared from these eggs, part emerged between October 17th and November 7th, the rest not until the following spring, and Gauckler, who obtained larvæ in August, 1883, at Hirschfeld, bred the imagines between September

16th and November 17th, 1883, and caught imagines, at light, at the end of September and commencement of October in 1889, at Carlsruhe and September 27th, 1896, and the following days, at the same place. Bartel says (*Pal. Gross-Schmett.*, ii., p. 19) that, in southern countries, the larvæ are to be found continuously from July to December and early January, he also states that the imagines emerge in central Europe from the end of July to October (but in southern countries in November and December), whilst hybernating pupæ disclose their imagines from April to mid-July. That the occurrence of the species in central Europe is much the same as in Britain is shown by the following records: June and again in October at Schwerin, May-June and September-October at Halle, in the spring very rare, in September-October, abundant at Leipzig, in May-June and September-October in Thuringia, in May and then very abundantly in September-October in Alsace, in May-June and September-October at Eperies and Budapest, in May-June and again in August in the Haute-Garonne. The Tuscany record — May, rare and again from August-October commonly—is not unlike our own, but there are records for "end of May," "September-October," and "December," for Sicily, where evidently southern conditions begin to prevail. The southern localities give "commencement of May" for Algeria, "April" for Fiume, "May" for Chiclana, &c., and May specimens are also recorded for Frankfort-on-Main, but they probably only mean immigrants corresponding with our own earliest recorded examples. In Roumania, August and September are noted, at Aix-les-Bains, July and August, in Transcaucasia, July to September, whilst the Eutin records are July to November. Fritsch gives dates varying from August 9th-November 12th, mainly, however, in September and October, for Austro-Hungary; he also has a record from Oberhaag for March 16th, and one from Weissbriach from which he draws the remarkable conclusion that the moth appears to hybernate, an idea hinted at by Réaumur (*Mémoires*, ii., p. 296) but without evidence; Aigner-Abafi quotes a few spring dates for Hungary, *viz.*, May 30th-July 14th at Budapest, June at Œdenburg, end of April for Fiume; he adds, however, that it is most abundant from the commencement of September to the middle of October, *e.g.*, August 10th-October 14th at Budapest, August 1st-8th at Fünfkirchen, &c. He puts (*Illus. Zeits. für Ent.*, iv., p. 211) the pupal period of the earliest-formed pupæ at 3 weeks, the late pupæ, he says, hybernate, the pupal stage lasting 286-290 days, but these pupæ he says rarely produce imagines unless forced. We may add that Ochsenheimer (*Die Schmett.*, ii., p. 236) records a case in which the pupal stage lasted $11\frac{1}{2}$ months. Hudák gives dates from September 3rd to October 18th, for Gölnitz, and Himsl notes September and again in mid-November for Upper Austria; Bachmetjew says that the insect is rare in Sofia in June, but sometimes common in October. The mass of the German, Austrian and French records, however, are for July - August, or August - September, or August - October, and one suspects that a study of our own detailed records will give as good ground for generalisation as those of Germany, Austria, or France, but neither the appearance of the species in our own, nor those in other countries, have been kept with sufficient accuracy to be of real scientific service. One point, however, bearing strongly on the view that the

species is not sedentary, and does not pass the winter naturally in central and northern Europe, is the fact that almost all places recorded as producing the species in the spring, are marked as "rare," or "very rare," whilst, in the autumn, they are marked as "common" or "very common," with, however, some qualification relating to the uncertainty of appearance, *e.g.*, the standard records for the Netherlands (Snellen), Switzerland (Frey), Brunswick (Heinemann), &c. Derenne's record for 1901, of larvæ in June in several localities in Belgium, the imagines occurring the following September suggest an egglaying period in May, and does not disagree much from that of Newman's record (*Ent.*, ii., p. 283) where he says: "Imagines in June, larvæ pupating July-August, most of the imagines emerging from October 1st-26th, the rest later at irregular periods." This variation in the length of the pupal period is a very real one, for forced pupæ respond very differently under the same forcing stimulus, *e.g.*, Pabst notes that, of 4 pupæ from larvæ that had gone to earth almost at the same time and were forced, 1 ♀ emerged December 1st, another ♀ December 7th, a ♂ December 20th, and a ♀ April 11th. The following dates of appearance from foreign sources may prove interesting: a ♀ imago on October 25th, 1900, at Guernsey (Lowe), on August 11th, 1885, a specimen came on board ship when at anchor off Algiers (Mathew), imagines September 16th, 30th, October 1st, 20th, 1900, at Pont-de-l'Arche (Dupont), June 9th, 1901, a specimen was taken on board ship off the north coast of Sicily (Fletcher), September 11th, 1892, at Chiasso (Knecht), October 13th, 1892, at Berne (Benteli), October 24th, 1893, at Berne (Hiltbold), July-August, 1896, at Aix-les-Bains (Agassiz), two imagines captured about September 29th, 1897, at Josnes, Loir-et-Cher (Harrison), imago flying in a room at St. Jean-de-Luz, Basses-Pyrénées, on August 29th, 1899 (Dupont). In Britain—September 22nd, 1842, at Heaton Park, another at Stalybridge about same time (Edleston), bred June 23rd, 1844, from pupa of preceding year at Horton Kirby (Rashleigh), September 15th, 1845, at Long Benton (Bold), April 18th, 1846, at Land's End (Noye), May 6th, 1846, at Barton-on-Heath (Goatley), May 30th, 1846, at sea, off the Casket Rocks (Bennington), August 7th, September 8th, 25th, 1846, at Land's End (Noye), 11 larvæ, 15 pupæ, and 3 imagines between August 1st-October 6th, 1846, at Chelmsford (Greenwood), 2 ♂ s August, 1846, at Hythe (Harding), October 12th, 1846, at Bristol (Vaughan), bred end of August-September 7th, 1846, at Ely (Fisher), bred October 11th, 1846, another July 7th, 1847, from larvæ that went down end of July, 1846, at Chipping Norton (Goatley), bred October 15th and 26th, 1848, from larvæ that pupated in July at Worcester (Curtler), June 12th, 1856, a fine specimen on the rocks near Scarborough (Langcake), June 28th, 1856, near Merthyr Tydvil (Parry), imago on July 9th, 1856, in the Isle of Wight (*Int.*, i., p. 139), bred August 6th, 1856, at Shanklin (Trimen), imago September 3rd, 1856, near Hayton (Armstrong), August, 1857, several at Topsham (Stanton), larva pupated at Leeds, end of August, 1857, and imago emerged October 11th, 1857 (Taylor), larvæ in August, 1857, at Ilfracombe, fullfed 1st week in September, emerged from October 5th, 1857, onwards (Mathew), May 30th, 1858, a fine specimen apparently just emerged at

Osborne (Winchester), July 22nd, 1858, at Canbury Fields, Kingston (Gower), bred September 7th-October 10th, 1858, from larvæ found at Brighton, July 30th-August 13th, and which pupated August 20th-21st (Image), 50 perfect imagines and 13 cripples bred between September 10th-November 27th, 1858, at Worcester (Edmunds), 4 ♂ s and 5 ♀ s forced between September 10th-25th, 1858, at temperature of 72°-80°F. at Greenwich, the pupæ laid between layers of wet moss (Groves), imago, September 13th, 1858, ♀, 6″ from tip to tip, at Windsor (Tyrer), September 15th, 1858, bred from pupa obtained at Woodford in August, 1858 (Thomas), from pupæ of the year imagines commenced emerging September 17th, 1858, at Ashford (Russell), on September 18th, 1858, imagines, pupæ and larvæ were alive together, three imagines emerging on that date at Newark (Gascoyne), imago September 20th, 1858, from larva that buried July 17th, at Woolwich, another imago September 20th, 1858, on rail of ship in Woolwich Dockyard (Potter), September 20th, 1858, at Ryde (Moon), imago September 20th, 1858, at Sharnbrook (Graham), bred two imagines September 21st, 1858, at Spring Hill (Hensman), September 22nd, 1858, imago emerged after pupal stage of 51 days at Sheffield (Laycock), September, 1858, at Witney (Stone), first appearances of imagines September 30th and October 1st, 1858, at Selby (Hobson), October 1st, 1858, one recently dead on the beach at Hythe (Briggs), emerged October 3rd, 1858, from larva that pupated on surface of ground on August 21st, at Epsom (Rogers), two imagines bred October 3rd, 1858, at Barnstaple (Mathew), October 9th, 1858, at Fenchurch Street (Reynolds), October 12th, 1858, at Hackney, at light (Hall), October 23rd-25th, 1858, bred at Newark (Gascoyne), [bred March 7th-15th, 1859, at Sandbach from pupæ said to have been found in January at Leicester (Heap),] imago emerged April 11th, 1859, from pupæ kept in a hothouse all autumn and winter, other pupæ kept in the hothouse emerged the previous autumn (Smith), imago emerged July 14th, 1859, from a larva found August, 1858, at Petersfield (Floud), September, 1859, at Bayswater (Allchin), September 17th, 1859, a ♂ taken wild, another bred on the previous day at Newark (Hadfield), October 5th-30th, 1859, seven imagines bred at Worcester (Edmunds), October 9th, 1859, at Twickenham (Boscher), October 10th, 1859, ♀ taken at Woolwich (Potter), October 18th, 1859, at Horndean (Hawker), May 23rd, 1860, picked up alive on the sea, and but little damaged by water off St. Leonards (Kent), September 30th, 1860, at Folkestone (Briggs), June 3rd, 1865, at Glenarm (Brunton), June, 1865, at Brighthampton (Stone), September, 1865, at Ipswich (Last), September 15th, 1865, at Wandsworth, October 4th, 1865, at Clapton (J. A. Clark), 19 imagines emerged by September 26th, 1865, from larvæ found at Worcester (Edmunds), August 13th, 1865, an imago found at Lytham, and another on September 8th (Gregson), imagines September 16th, 1865, from larvæ found at Epping, in July (Doubleday), 7 larvæ in July, 1865, at Gloucester, pupated and 5 emerged during September, 2 ♂ s and 3 ♀ s, another ♀ caught at Gloucester on October 3rd, 1865 (Merrin), reared larvæ, from which about a dozen imagines had emerged, at Woodbridge, by October 11th, 1865 (Browne), 6 imagines during the week ending October 7th, 1865, at Henley-on-Thames (Stubbs),

one about October 7th, 1865, at Pevensey, and others at Eastbourne on October 12th, at Seaford on October 10th, and yet another at Eastbourne on October 14th (Dutton), September 3rd, 1866, at Cambridge (J. A. Clark), July 6th, 1867, at Lewes (Jenner), imago July 7th, 1867, at Cockermouth (Mawson), September 12th, 1867, at Burley (Liversidge), September 12th, 1867, ♂ at Leeds (Wilson), October 5th, 1867, at Halifax (Baxendale), September 27th, 1868, at Dumfries (Lennon), June 24th, 1869, from larvæ found at Folkestone September 1st-8th, 1868 (Briggs), July 6th, 1869, an imago at Lewes (Jenner), one on November 6th, 1870, at Mansfield (Daws), September 1st, 1871, at Oxton (Studd), a ♂ emerged October 23rd, 1871, from Lyndhurst larva (*Ent.*, v., p. 428), one November, 1874, at Reading (Holland), September 7th, 1875, in Parliament Street (Duprey), emerged October 30th, 1875, from larva found at Mapledurham on August 26th (Holland), September 27th, 1876, at Exeter (Hellins), just before October 21st, 1876, at Folkestone (Giles), May 29th, 1877, at Welbeck Abbey (Rolfe), August 19th, 1877, at Ipswich (Miller), early September, 1877, an imago in the Scilly Islands (Crewe), May 6th, 1878, on South Devon coast (Walker), May 9th, 1878, imago near seashore at Glenarm Castle (Brunton), imago May 18th, 1878, at Harwich (Kerry), June 8th, 1878, at Schull (Flemyng), August 29th, 1878, at Douglas (Birchall), September 17th, 1878, on a voyage at sea between Scarborough and Penzance (Daws), June 4th, 1879, at Coolinge (Cheesman), September, 1879, off coast of Harwich (Frohawk), about September 18th, 1879, at Ascham (Pritchard), June, 1880, at Jedburgh (Elliot), June 19th, 1881, at Manchester (Axon), June 19th, 1881, at Higher Broughton (Credland), August 16th, 1881, at Melton, October 10th-November 1st, 1881, at Aylestone (Bouskell), October 10th-November 1st, 1881, at Portland (Sykes), May 2nd, 1882, near Royal Exchange, London (Sayer), imagines very common at Deal, in the autumn, of 1882. (Hall), September, 1882, near Gifford (Brotherston), September 24th, 1882, at Culleenamore (Russ), October 2nd, 1882, at Grantham (Treadgold), September 14th, 1883, at Edinburgh (Carter), September 17th, 1883, at Chichester (Anderson), September 20th, 1883, at Parkeston (Kerry), end of September, 1883, at Canterbury (Kingsford), October, 1883, at Woolston (Butt), imago June 14th, 1884, at Chichester (Anderson), imago June 14th, 1884, at Culleenamore (Russ), bred July 21st, 1884, from larva found September, 1883, at Chichester (Anderson), September 6th, 1884, at Derby (Nixon), 3 imagines taken on vessel far from land in North Sea (Cordeaux, *Nat.*, August, 1884), September 8th, 1884, at Girlington (Carter), September 20th, 1884, at Deal (Harbour), October 22nd, 1884, at Liverpool (Cooke), imagines June 27th, 1885, at Leicester (Rowley), August 12th, 1885, at Abbotsbury (Hopson), larva September 2nd, 1885, at Christchurch, pupa forced and imago emerged, November 29th (Druitt), September 19th, 1885, at Caledon (Johnson), September 28th, 1885, at Branstone (Nowers), 8 pupæ in 1885, 5 of which were forced from the last week in October, imagines emerged on December 19th, January 7th, February 1st and March 21st, the other died, at Wells (Livett), November 10th, 1885, at Christchurch (Adye), bred January 2nd-5th, 1886, from pupæ kept

at temperature of 60°-70° F. (Dobson), bred February 8th, 1886, at Lewes (Nicholson), May 18th, 1886, in Greenwich (Levett), June 14th, 1886, at Sligo (Russ), August 1st, 1886, from pupa obtained September 22nd, 1885, at Leatherhead (Briggs), July 20th, 26th, 30th, August 3rd, 1886, all ♀s, from larvæ found at Chichester, in the autumn of 1885 (Anderson), larva autumn of 1885, at Reading, pupated, imago appeared July 24th, 1886 (Butler), August 11th, 1886, at Folkestone (J. A. Clark), June 2nd-5th, 1886, from pupæ, kept in temperature of 60°-70°F. (Newnham), about October 1st, 1886, at Howth (Fetherstonhaugh), September 25th, 1886, at Oxwellmains (Evans), 4 larvæ 1886, at Leominster, three pupated and produced imagines about the middle of September, the 4th emerged November 6th (Hutchinson), larvæ from August 9th, 1887, 7 imagines bred October, 1887, at Brentwood (Burrows), September 2nd, 1887, at Portland (Sykes), a ♀ on September 12th, 1887, at Christchurch (Adye), 2 imagines September, 1887, at Galashiels (Pringle), September 15th, 1888, at Maldon (Furbank), September 17th and 19th, 1888, at Bexhill-on-Sea (Howe), an imago in the spring of 1889, at Taunton (Farrant), several larvæ at Hornsea, end of August, 1889, 1st imago emerged November 1st, all had emerged but one by November 20th (Inchbald), September, 1889, distributed in the Isle of Wight (Hodges), imago October 18th, 1889, from larva found at Blandford in August (Smith), October 21st, ♀, October 22nd, ♀, November 17th, 1889, at Gosport (Pearce), emerged at Maldon, July 22nd, 1890, from pupa obtained from larva found feeding on *Lycium* in 1889 (Fitch), a ♂ taken at Selsey, September 24th, 1890 (Anderson), June 15th, 1891, near Chichester (Anderson), June 29th, 1891, at Musselburgh (Evans), August 29th, 1891, at Barnsley (Brady), September 25th, 1891, at Ripon (Chapman), imago October 8th, 1891, at St. Anne's-on-Sea (Baxter), about October 12th, 1891, at Gosport (Mackett), imago taken at Laxey Glen, October 22nd, 1891 (Clarke), a ♂ on October 22nd, 1891, at Maidstone (Sandlin), imago July 27th, 1892, at Morpeth (Finlay), June 1st, 1893, at Kibworth (Cruttwell), two larvæ, August 15th, 1892, at Folkestone, one died, the other emerged October 14th, 1892 (Burne), ♂ imago emerged about October 14th, 1892, from pupa found at Clevedon (Mason), imago September 2nd, 1893, at Seaford (Hill), larvæ July 15th 19th, 1893, imagines bred September 15th-October 9th, 1893, one caught September 23rd, at Rainham (Burrows), October 10th and 11th, 1893, at Corfe Castle (Bankes), imago July 2nd, 1894, at Bramfield (Pyett), imago August 14th, 1894, at Fremington (Bunn), larvæ August 9th-17th, pupæ September 2nd-12th, imagines bred October 10th-December 15th, 1894; also larvæ July 20th-25th, imagines bred October 17th, &c., 1895, at Rainham (Burrows), imago September 2nd, 1895, at Tramore (Power), September 14th, 1895, at St. Agnes (Frohawk), September 17th, 1895, at Kingston-on-Thames (Wollstein), September 20th, 1895, at Bessbrook (Johnson), September 21st, October 4th-28th, 1895, at Prescot (Freeman), September 22nd, and October 21st, 1895, in Cumberland (F. H. Day), September 24th, 1895, at East Croydon (Hall), imagines September 29th, 30th, October 15th (2), October 18th, 1895, at Market Drayton (Woodforde), imago October 3rd, 1895, at Colyford (Chope), one

imago last week in September, 1895, at Chichester (Anderson), imago at rest about October 11th, 1895, at Clevedon (Mason), October 19th, 1895, at Walthamstow (J. A. Clark), October, 1895, at Huddersfield (Porritt), October 28th, 1895, in Devonshire (T. Briggs), fullgrown larva August 23rd, 1895, pupated and an imago emerged November 17th, at Little Smeaton (Brady), July 3rd, 1896, at Elgin (Brown), beginning of July, 1896, at Harelaw, near Aberlady (Evans), a fine imago emerged July 17th, 1896, from an 1895 pupa from Chichester (Anderson), July 18th, 1896, at King's Lynn (Atmore), August 1st, 1896, at Ringwood (Fowler), imago just before August 6th, 1896, near Ballindud (Bonaparte-Wyse), August 10th-11th, 1896, at Lewes (Leech), September, 1896, at Giffnock (Dalglish), September, 1896, one at Tonge Colliery and one at Astley Bridge, near Bolton (Whitaker), imago early September, 1896, at Littlehampton (Helps), September 9th, 1896, at Swanage (Hall), September 9th, 1896, at Egg Buckland (Briggs), September 10th, 1896, at Bishopton (Angus), September, 1896, at Springhill (Evans), September 11th, 1896, at Culross (McGregor), a wild imago caught September 13th, 1896, at Elrington (Walker), imago taken wild September 14th, 1896, at Sandown (Prout), imago caught at Framwelligate Moor, September 16th, 1896 (Maddison), imago September 17th, 1896, at Bradford (Carter), September 18th, 1896, at Edinburgh (Burn), one captured at Douglas on September 26th, 1896, others taken at Sulby on October 3rd, and on October 14th, at Ramsay (Clarke), larvæ July 20th-27th, imagines bred October, 1896, at Rainham (Burrows), of some 30 pupæ at Beverley in 1896, forced, six imagines emerged five in October and one April 17th, 1897 (Newnham), October, 1896, at Hayling Island (May), imago emerged on October 3rd, 1896, from a larva taken at Whitchurch, which pupated July 21st (Griffiths), two emerged October 8th, 1896, in a cool outhouse at Potton (Bond-Smith), imago emerged October 15th, 1896, forced from larva which pupated September 15th, temperature of water kept at about 105°F. (Heath), 13 larvæ obtained in Lincolnshire in the autumn of 1896, 9 successfully pupated and 6 fine moths emerged by October 8th (Brady), imago October 15th, 1896, from West Purley, Wimborne (Chudleigh), bred October 19th, 24th, 27th, 1896, at Reading (Butler), bred three, one emerged October 31st, 1896 (Prout), bred from larva found at Hythe, emerged (forced) November, 1896 (Adkin), November 25th, 1896, from a larva found at Walthamstow (J. A. Clark), 4 pupæ in September, 1896, placed in greenhouse, with day temperature of 60°-70° F. and night temperature of 50°-60° F., all four emerged in November, 1896 (Christy), April-June, 1897, in Alderney (Wells), June 12th, 1897, at Paisley (Ross), July 20th, 1897, from an 1896 pupa, at Bury St. Edmunds (Norgate), three imagines emerged July 26th, 1897, from 1896 pupæ, at Chichester (Anderson), imago September 2nd, 1897, at Patricroft, near Manchester (Buckley), September 3rd, 1897, at Stromness (Cheesman), September, 1897, at Galashiels (Haggart), July 14th, 1898, at Corsemalzie, another on July 19th, at Quhillart (Gordon), larva in August, 1898, at Staithe, went down in September, kept in a cool place and emerged July 14th, 1899 (Lofthouse), September, 1898, an imago at Dorking (Oldaker), September, 1898, at Lochwinnoch (Dalglish), September 12th, 1898, in the Scilly Isles (Adkin), September 30th, 1898, at Paul (Daws),

imago October 3rd, 1898, at Tunbridge Wells (Dallas-Beeching), October 10th, 1898, at Castle Carrock (Routledge), October 12th, 1898, at Middlesborough (Sachse), October 14th, 1898, at Quhillart (Gordon), October 21st, 1898, at Warwick, near Carlisle (F. H. Day), imago middle of May, 1899, at Chester (Arkle), June 1st, 1899, at Little Salkeld (Britten), larvæ from July 24th, 1899, through August, one imago emerged under natural conditions on September 20th, 1899, the others apparently going over the winter (Atmore), imagines August 21st, 1899, in Sutherland (Christy), larva August 23rd, 1899, at Thornaby, went down August 27th, imago emerged indoors on November 19th, 1899 (Lofthouse), August 1899, at Marlow (Cardinall), imago emerged September 1st, 1899, from a larva taken at Easton-in-Gordano, which pupated July 29th (Griffiths), 7 pupæ from Angmering, gave 5 imagines during September and October, 1899 (Dollman), a dozen pupæ, September 3rd-5th, 1899, from Long Sutton district, imagines emerged September 25th, 26th, 28th and on (Brooks), September 7th, 1899, very vociferous, at Guernsey (Luff), two pupæ on September 12th, 1899, at Penarth, one emerged on September 16th, the other on the 18th (Howe), imago emerged, forced, on September 17th, 1899, at Dover (Stockwell), September 18th, 1899, at Hereford (Pilley), ♀ at Chichester, September 19th, 1899 (Anderson), September 20th, 1899, at Timoleague (Donovan), three emerged, forced, between September 21st and October 1st, 1899, from Emsworth (Christy), September 25th, 1899, at High Wycombe (Peachell), September 27th, 1899, at Painswick (Watkins), ♂ on September 30th, 1899, at Penzance (Daws), imago on October 6th, 1899, at Dover (Shaw), imagines emerged, without forcing, from Dover pupæ on October 7th-18th, 1899 (Colthrup), three pupæ the first week of October, 1899, at Waltham Cross, one emerged at once, another directly afterwards, the third died (Bowles), imago at Padworth, October 9th, 1899 (Garrett), three imagines emerged about the middle of October, 1899, from pupæ found at Sudbury in September (Ransom), imagines emerged October 14th and December 3rd, 1899, from larvæ found September 1st-25th, at Mundesley (James), imago emerged November 12th, 1899, from a larva found at Broadstairs on August 30th (Russell); Kay notes one imago in the spring of 1900, at Hayton, and Whitaker one on the night of June 18th, 1900; June 23rd, 1900, at South Leverton (Thornley), July 10th, 1900, at Kilmarnock (Rose), August 4th, 1900, at Scarborough (Lownsboro), August 19th, 1900, at Boston Spa (Prince), 26 larvæ at Stowmarket in July and early August, 1900, pupated, forced, first imago emerged September 28th, 1900, others continued till end of October, when 23 imagines had emerged, 2 pupæ were dead and one appeared to be going over the winter (Baker), larvæ August 2nd to October 12th, pupæ October 6th-20th, imagines bred October 12th, 1900-January 6th, 1901, at Mucking (Burrows), August 26th, 1900, at Hampstead (Hopson), August 30th, 1900, at Horsforth (White), August 30th, 1900, at Keighley (Longton), imago September 18th, 1900, at Hereford (Pilley), September 20th, 1900, at Glasgow (Dalglish), September 20th, 1900, bred at Sandwich (*teste* Colthrup), September 26th, 1900, at Emsworth (Christy), imago September 29th, 1900, at Timoleague (Donovan), larva August 27th, 1900, at

Natland, pupated and produced imago on October 30th, larvæ August 25th, at Low Foulshaw, August 30th-31st, at Helme Lodge, near Kendal, September 1st-8th in Kendal; also several pupæ in Kendal district from October 5th-November 3rd, 1900, 4 of those obtained in August as larvæ buried in moist cocoanut fibre from September 4th-6th, during October and November the box was placed every day before sitting-room fire (sometimes up to 90°F.), imagines appeared —♂ on November 11th about 9 p.m., ♂ November 12th about 9 p.m., ♂ November 16th about 12 p.m., ♀ November 24th about 9 p.m. (Moss), imago in the Strand, London, October 3rd, 1900 (Doncaster), bred on October 18th, 19th, 24th, 25th, 1900, from larvæ taken at Margate (Russell), several fullfed larvæ between August 10th-20th, these pupated, and, from October 15th-22nd, 1900, three emerged, forced, at Feering Bury (P. C. Reid), October 22nd, 1900, in York (Hawkins), imago emerged October 21st, 1900, from larva found at Mundesley on September 2nd, another imago emerged October 23rd, 1900, from larva from Waldringfield (James), imagines bred from November 9th, 1900, pupæ kept at fairly constant temperature of 90°F., at Kendal (Littlewood), 120 pupæ in the autumn of 1900 at Market Drayton, from these 30 imagines emerged after forcing, the earliest in the beginning of November, 1900, and the last in early May, 1901, when three living pupæ still remained (Woodforde), many larvæ in September, 1900, on October 15th fourteen pupæ were placed in forcing apparatus, and emergences occurred November 1st, ♀, November 3rd, ♂, November 7th, two, November 11th, one, November 12th a ♂, November 13th a ♀, November 14th a ♀, November 15th another, and on November 16th the last, the rest of the pupæ died (Cowl), June 2nd, 1901, at Murchison (Evans), June 7th, 1901, at Blaxton (Corbett), June 8th, 1901, at Castlesides (Almond), June 18th, 1901, at Worsborough Bridge (Whitaker), a specimen taken at Middlesborough, June 10th, 1901, another at Saltburn in the latter part of September (Lofthouse), imago September 7th, 1901, at Ardpeaton (Evans), bred September 9th, 1901, at Bonhill (Malloch), many larvæ on August 8th, imago September 14th, 1901, at Hartlepool (Robson), ♀ imago taken at large on September 17th, 1901, at Ringwood, larvæ and pupæ were taken in numbers up to October 11th, 1901, at Ringwood, one imago emerged on September 17th, and from then during October imagines came out almost every day (Fowler), imago September 30th, 1901, at Cleckheaton (Crosland), imago beginning of October, 1901, at Knutsford (Day), imago, October 4th, 1901, at Worthing (Lawrance), October 11th, 1901, a newly-emerged ♀ at Guernsey (Lowe), imago, early October, 1901, at Bow (Milton), October 14th, 1901, at Haydon Bridge (Mandell), a dozen larvæ in August, 1901, of which one pupated August 20th, imago appeared October 6th, another pupated on September 21st, imago emerged November 19th, another pupa forced from November 23rd, emerged January 10th, 1902, at Kendal (Littlewood), imago, October 16th, 1901, at Truro (Rollason), a fullgrown larva, on October 6th, 1901, at Great Salkeld, another October 14th, 1901, and one pupa and one larva just turning, October 16th, 1901, the first imago from these emerged on November 18th, 1901 (Britten), October 1st, 1902, at Lindal Bank (Petty), imago on cruiser, April 28th,

1903, off Southwold (Mathew), imago, May 15th, 1903, at Saltaire (*Ent.*, xxxvi., 193), imago, May 21st, 1903, at Ipswich (Hocking), September 8th, 1903, at Stanford-le-Hope (Burrows), October 27th, 1903, resting on a plane tree in Lincoln's Inn Fields (Doncaster), October 29th, 1903, at Tunbridge Wells (Dallas-Beeching).

LOCALITIES.—Distributed all over the British Islands in some seasons, in others quite absent. In Ireland, immigrants disperse themselves over every part of the island sometimes in considerable numbers in suitable years (Kane). ABERDEEN: Aberdeen (Esson), Inverurie, Pitcaple (Reid), Banchory (Dunbar), forest of Glentanner (Jones). ANTRIM: Glenarm Castle (Brunton), Ballycastle (Milne), Lisburn, Stears (Watts). ARGYLL: Campbelltown (Dalglish), Kirn (M'Corkle), Kilmartin district (Allison), Ardnamurchan (Murdoch). ARMAGH: Bessbrook (Johnson). AYR: Lendalfoot (Wilson), Kilmarnock (Rose), Monkton (Duncan). BANFF: Banff (Edward). BEDFORDSHIRE: Felmersham, Sharnbrook (Graham), Potton (Bond-Smith), Stagsden, Bedford (Greenwell-Lax), Luton (Jennings). BERKS: Windsor (Tyrer), Newbury (Fordham), Reading (Holland), Twyford (Butler), Padworth (Garrett). BRECKNOCK: Hoy (Imms). BUCKS: Bow Brickhill (Burney), Haddenham (Barton), Wolverton (Barlow), High Wycombe (Peachell), Slough (Williamson), Buckingham (Slade), Marlow (Cardinall). CAITHNESS: St. Andrews, Wick (Sandison), Billister, Bower, Keiss (Dunbar). CAMBRIDGE: Cambridge (J. A. Clark), Fen district (Balding), Fulbourne (Henderson), Wisbech (Glenny), Ely (Fisher), Royston (Wilson). CARMARTHEN: Bank near Merthyr Tydvil (Parry), Langharne (Kaye), Carmarthen (Wilson). CARNARVON: Abersoch (Arkle), Deganwy (Gardner). CHESHIRE: Chester and the county generally (Arkle), Bowdon (Thorpe), Alderley Edge (Oldham), Christleton, Tattenhall (Manning), Saughall near Chester (Shrubsole), Upton near Birkenhead (Archer), Tranmere (Prince), Vicar's Cross (Pitcairn-Campbell), near Knutsford (Day), Tabley (Warren), Eccleston, Kinnerton (Dobie), Hoylake (Gardner), near Malpas (Thornewill), Farndon (Newstead), Carrington (Stubbs), Bidston (Gregson), Liscard (Cooke), Delamere (Walker), Heaton Park, Stalybridge (Edleston). CLACKMANNAN: Alloa (Borthwick). CORK: Schull (Flemyng), Butterstown, Timoleague (Donovan), Bandon (Longfield), Ballinasloe (Dillon). CORNWALL: Scilly Isles, Tresco (Crewe), St. Agnes' lighthouse (Frohawk), Land's End (Noye), Penzance, Paul (Daws), Truro (Rollason), East Looe (Clogg), Lostwitheil (Bracken), Launceston (Hayward). CUMBERLAND: near Hayton (Armstrong), Keswick (Beadle), Carlisle, Penrith, Salkeld, Warwick near Carlisle, Cummersdale (F. H. Day), Brampton, Castle Carrock (Routledge), Cockermouth (Mawson), Silloth near Carlisle (Wilkinson), Netherton (Fawcett), Great Salkeld, Little Salkeld (Britten). DENBIGH: Colwyn Bay (Newstead). DERBY: occasionally throughout the southern half of county (Payne), Burton-on-Trent (Baker), Little Eaton, near Derby (Nixon), Branstone (Nowers), Willington (Smallwood). DEVON: Dartmouth (Lighton), Braunton, Bishopsteignton (Bracken), Oxton (Studd), near Exeter (Potter), Ilfracombe, Barnstaple (Mathew), Plymouth (Ryder), near Honiton (Riding), Egg Buckland (Briggs), Starcross (Jäger), Topsham (Stainton), Westward Ho (Gosset), Dartington (Hellins), Sidmouth (Majendie), Fremington (Bunn), Colyford (Chope), Devonport (Hayward). DONEGAL: Greencastle (Hart). DORSET: Abbotsbury (Hopson), Portland — Pennsylvania (Sykes), Sherborne (Garland), Swanage (Hall), Corfe (Bankes), Bloxworth (Cambridge), Weymouth (Richardson). DUBLIN: Howth (Fetherstonhaugh). DUMBARTON: Bonhill, Vale of Leven (Malloch), Ardpeaton (Evans). DUMFRIES: Cluden, near Dumfries, Lockerbie (Service), Dumfries (Lennon). DURHAM: common at times in the county (Robson), South Shields, Darlington (Eales), near Durham (Maddison), Castlesides (Almond), Shull (Backhouse), Sunderland (Brady), Hartlepool (Robson), Framwellgate Moor (Maddison). EDINBURGH: Edinburgh (Burn), Murchiston, Oxwellmains, Musselburgh (Evans), Joppa (Carter). ESSEX: Maldon (Fitch), Woodbridge (Browne), East Mersea (Cole), Leigh (Vaughan), Harwich (Kerry), Walthamstow (J. A. Clark), Ilford, Stratford (Eedle), Colchester (Harwood), Chelmsford and dist. (Miller), Woodford (Thomas), Wanstead, Brentwood, Rainham, Mucking (Burrows), Earl's Colne (Tawell), Saffron Walden (Jäger). Southend (Whittle), Feering Bury (Reid), Epping (Doubleday), Dovercourt (Mathew), Rivenhall (Cattle). FIFE: Newport (Berry), Culross (McGregor). FLINT: Bagillt (Walker), Overton (Willoughby-

Gardner), near Overton (Perkins), Farndon (Newstead). GALWAY: Galway, Clonbrock (Dillon), Connemara (Birchall). GLAMORGAN: Penarth (Howe), Porthcawl (Frohawk). GLOUCESTER: larvæ sometimes abundant in district, Durdham Down, Westbury-on-Trym, New Passage (Griffiths), Thornbury, Leckhampton, Cheltenham (Trye), Newnham, Gloucester (Biugham), Painswick (Watkins), Wotton-under-Edge (Perkins), Pitville, Prestbury (Robertson), Burford (Hallett-Todd), Bristol dist. general (Hudd), Stonehouse (Nash), Dursley (Bartlett), Cirencester (Jefferys). HADDINGTON: near Gifford (Brotherston), Dunbar, Harelaw, near Longniddry Prestonkirk (Guthrie), near Aberlady, Tranent (Evans). HANTS: Isle of Wight (*Int.*, i., p. 139), Shanklin (Trimen), Sandown (Prout), Ryde (Moon), Osborne (Winchester), Ventnor (Broomfield), Long Benton (Ingram), Horudean (Hawker), Winchester (Johns), Southampton (Oakley), Fordingbridge (Neave), Lyndhurst (Lockyer), Basingstoke (Holdaway), Brockenhurst (Henderson), Hayling Island (May), Petersfield (Floud), Christchurch (Adye), Buckland, Portsmouth (Pearce), Gosport (Mackett), Boscombe (Robertson), Ringwood (Fowler), New Forest (Gosset), Woolston, near Southampton (Bull), Emsworth (Christy), Portsdown, Landport, near Portsea (Moncreaff), Romsey (Buckell). HEREFORD: Leominster (Hutchinson), Hereford (Pilley), Tarrington (Wood), Buckfield (Newman). HERTS: Hitchiu (Griffith), Watford (James), Lilley (Jennings), Elsenham (Cornell), St. Albans (Gibbs). HUNTS: St. Ives (Norris), Ramsey (Raynor). ISLE OF MAN: Sulby, Ramsey (Lezayre), near Castletown Laxey, Douglas (Clarke). KERRY: Killarney (Kaue). KENT: Rochester and Chatham districts, some seasons common (Chaney), Hither Green (Morris), Fordwich (Cox), Wateringbury (Fremliu), Greenwich (Groves), Chatham (Lewcock), Ramsgate (Willson), Hythe (Adkin), Ashford (Russell), Woolwich (Potter), Folkestone (Giles), Coolinge (Cheesman), Lee, New Eltham (Bower), Strood (Latchmore). Deal (Harding), Sandwich (*teste* Colthrup), Broadstairs, Margate (Russell), Canterbury (Kingsford), Chislehurst (Cockerell), Maidstone (Sandlin), Dover (Pickett), Bexley (Newman), Farnborough (Alderson), Tunbridge Wells (Shepheard-Walwyn), Horton Kirby (Rashleigh), Sheerness (Walker), Ewell (Hills), Sheppey district (Walker), Hampstead (Hopson), between Sandwich and St. Margaret's Bay (Shepherd), Hawkhurst (Adams). KIRKCUDBRIGHT: Borgue (Service). LANARK: Glasgow (King). LANCASHIRE: of frequent occurrence (Ellis), north Lancashire, generally distributed (Hodgkinson), Bootle (Gregson), Hale (Capper), Liverpool (Cooke), Seaforth (Weightman), Leigh (*Ent. Wk. Int.*, 1859, p. 27), Astley Bridge, near Bolton (*teste* Whittaker), Fleetwood (Taylor), near Manchester (Buckley). Crosby (Jones), St. Helens (Cotton), Lytham (Gregson), Formby (Service), Carnforth (Murray), St. Aune's-on-Sea (Baxter), Lancaster (Taylor), Liverpool district (West), Blackpool (Thorpe), Heaton Park, Stalybridge (Edleston), Higher Broughton (Credlaud), near Leigh (Daniels), Preston (Hodgkinson), Prescot (Freeman), Ulverston, Lindal Bank (Petty). LEICESTER: periodical, sometimes commou (Bloomfield), Leicester (Heap), Mountsorrel, Knighton (Storer), Loughborough (Wieldt), Gumley (Matthews), Aylestone (Browu), Melton (Bouskell), Kibworth (Cruttwell). LINCOLNSHIRE: East Stockwith, Gainsborough (Forington), Lincolu (Musham), Alford (Mason), Ranceby near Sleaford (Stow), Great Grimsby (Dawson), Brant Broughton (Stow), Market Rasen (Lewington), Boston (Lane-Claydon), Grantham (Walpole), Louth (Renton), Great Cotes (Quirk), Long Sutton, Panton (Raynor), Brigg (Norman), Ballinghay (Walker). LONDONDERRY: Londonderry (Campbell). MERIONETH: Barmouth (Roberts). MIDDLESEX: Edmonton (Downing), Parliament Street (Duprey), Claptou (J. A. Clark), Bayswater (Allchin), Enfield, Waltham Cross (Bowles), Twickenham (Boscher), Hackney (Hall), Harrow (Walker), Shepperton-on-Thames (Russell), Roxeth (Prior), Kingsbury (Bond), Greenhill (Rhoades-Smith), Mill Hill (South), Chiswick (Sich), Isleworth (Myers). MONAGHAN: near Drumreaske (Kane). MONMOUTH: Wye Valley, near Builth (Vaughan), Beachley, near Chepstow, near Monmouth, Newport (Parry). MONTGOMERY: Newtown (Tetley). MORAY: Elgin, Rosefield (Brown). NORFOLK: Scole (Barton), Ranworth (Winter), Mundesley (James), Fakenham (Woolhouse), Norwich (Laddiman), Wisbech (Balding), King's Lynn (Atmore), Ingoldesthorpe (Newstead), Great Yarmouth (Waters). NORTHAMPTON: Spring Hill (Hensman), Peterborough (Cottam), Northampton (Imms), Kettering (McDowall). NORTHUMBERLAND: common at times in the county (Robson), Hexham, Monkseaton, Creswell Hall (Howse), Hayton Bridge (Morison), Chathill (Allhusen), Felton Hall (Wallis), River Green Mill, near Morpeth (Finlay), Winlaton Mill (Balmer), Dunston (Hedworth), Newcastle-on-Tyne (Maling), near Jesmond (Henderson), Long Benton, Berwick Hill (Bold), Lilburn Tower, Wooler, Plea Piece, near

Ancroft, Smefield, Holy Island, Brock Mill, near Beal (Bolam). NOTTINGHAM: Newark (Hadfield), Chilwell, Beeston (Pearson), Mansfield (Brameld), Tuxford (Gain), South Leverton (Thornley), Langar (Leivers), Blidworth (Carr), Welbeck Abbey (Rolfe). ORKNEY AND SHETLAND: Dingwall (Davidson), St. Andrews (Sandison), Stromness (Cheesman), Lerwick, Stony Hill (Gardner). OXFORD: Oxford (Meldola), Caversham, Henley, Mapledurham (Holland), Brighthampton, Witney (Stone), Kingston (Mitchell), Eynsham, Headington (Thompson). PEEBLES: Upper Kidston (Graham), Springhill (Evans). PEMBROKE: Castlemartin (Hodge), Tenby (Jefferys). PERTH: sometimes rather common in the larval state—the Forth, Earn, Gowrie, Perth and Rannoch districts (White), Dall (Blackburn), Moncrieff, Muirhall (White), Culross (McGregor). RENFREW: Giffnock, Lochwinnoch, Paisley (Dalglish), Port Glasgow (Taylor), Bishopton, near Paisley (Angus), Milliken Park (Watson), Renfrew (Scott), Greenock (Gray). ROXBURGH: Jedburgh, Ormiston, Caverton dist. (Elliot), Galashiels (Pringle), Hawick dist., occasionally (Guthrie). RUTLAND: Uppingham (Bell). SHROPSHIRE: Market Drayton dist. (Woodforde), Newport (Andrews), Ascham (Pritchard), Whitchurch (Thornewill), Lilleshall (Andrews). SLIGO: Culleenamore (Russ), Sligo (Kane). SOMERSET: Bristol coalfield district, generally distributed (Hudd), Porlock (Tunaley), Taunton (Rawlinson), Minehead (Bonnor), Bridgwater (Sanders), Whitchurch, Easton-in-Gordano (Griffiths), Stanton Drew (Greer), Castle Cary (Macmillan), Clevedon (Mason), Wellington (Milton), Wells (Livett). STAFFORD: North Staffordshire, Onneley, Madeley, Uttoxeter, (Daltry), Leckhampton (Trye), Rugeley (Freer), Stone, Cheadle (Masefield), Oulton (Blagg), Market Drayton dist. (Woodforde), Stafford (Douglas), Cannock Chase (Wynn), Wellington (Smallwood). STIRLING: Campsie (Cross). SUFFOLK: Ipswich (Miller), Woodbridge (Freeman), Carlton Colville (Donisthorpe), Sudbury very rare, Long Melford, Chilton (Ransom), Bentley (Burrows), Hadleigh (Grimwade), Waldringfield (James), Wolverstone near Ipswich (Bree), Brantham (Buckell), Middleton and Westleton near Saxmundham (Woods), Aldeburgh (Cooper), Stowmarket (Baker), Saffron Walden (Jeffrey), Cavendish (Wilson), Bury St. Edmunds (Norgate), Bramfield, Halesworth (Pyett). SURREY: near Reigate (Wollaston), Dorking (Watney), Epsom (Rogers), Putney (Stevens), Wandsworth (J. A. Clark), Tooting (Wood), Haslemere (Barrett), Ashstead, Headley, Banstead (Jones), Surbiton, Kingston (Goss), Redhill (Beadnell), Guildford (Grover), Lower Tooting, Merton (Sparke), East Croydon (Hall), Leatherhead (Briggs), Thornton Heath (Lindemann). SUSSEX: East Sussex district (Jenner), West Sussex—Worthing district, etc. (Fletcher), Brighton district, common 1857 (Kane), Lewes (Nicholson), Bognor (Edgell), St. Leonard's-on-Sea (Kent), Chichester, Selsey (Anderson), Uckfield (Hay), Hastings, Guestling (Bloomfield), Littlehampton (Helps), Battle (Ellman), Hove (Turner), Worthing district (Fletcher), near Emsworth, Pulborough (Christy), Handcross (Briggs), Seaford (Hill), Steyning (White), Bexhill-on-Sea (Howe), Portslade (Cardwall), Angmering (Dollman), Slindon (Giles). SUTHERLAND: (Christy). TIPPERARY: Clonmel (Davis). TYRONE: Caledon (Johnson), Kilskeery (Brakey). WARWICK: Coventry (Harcourt-Bath), Barton-on-Heath (Goatley), Birmingham (Imms), Knowle (Ellis), Atherstone (Baker), Chalcot (Harrison). WATERFORD: Tramore (Power), Cappagh (Ussher), near Ballindud (Bonaparte-Wyse). WESTMORLAND: Kendal, Lyth, Lindale near Grange, Helsington, Witherslack, Stainton (Moss), Arnside, Burton (Murray), Natland and Foulshaw districts (Holmes). WICKLOW: Kilcool, Wooden Bridge (Fitzgibbon), near Bray (Kane). WIGTOWN: Cairnryan (Bruce), Stranraer, Whithorn, Portwilliam, Garlestown, Corsemalzie, Quhillart (Gordon). WILTS: Bremhill, Calne (Eddrup), Marlborough (Preston), Salisbury district—Britford, Harnham, Broadchalke, Wylye, Winterbourne, Kingston (Morres). WORCESTER: near Worcester, Bricklehampton (Rea), Malvern Wells district (Mason), Evenlode (Mitchell), Witley Park (Edmunds), Malvern Link (Day), Malvern (Edwards). YORKS: occurs now and then in all parts of the county, and in the potato-growing districts of the east and southeast is sometimes very plentiful in the larval state (Porritt), Middlesborough, Saltburn, Redcar, Staithe (Lofthouse), Selby (Hobson), Sheffield (Laycock), Wetherby (Firby), Hull (Young), York district (Anderson), Leeds (Taylor), Rotherham (Rodgers), Guisborough (Jeffrey), Elrington (Walker), Scarborough (Langcake), Hartlepool (Cambridge), Girlington, near Bradford, Heaton (Carter), Cudworth, Little Smeaton, Barnsley (Brady), Pateley (Storey), Newton Kyme (Chaloner), Irton (Clarke), Kirkburton (Porritt), Copmanthorpe, Driffield, Beverley (Hewett), Wakefield (Parkin), Goole (Bunker), Ripon (Chapman), Horsforth, Netherton (White), Blaxton, Doncaster (Corbett), Easington (Loten), Cleckheaton (Crosland), Warmfield (Townsend), Kildale, (Sachse), Hovingham Hall (Worsley), Boston Spa (Prince), Keighley (Longton), Beningbrough (Hewett), Bridlington (Hobson), Normanton (Townsend), Skipwith

(Ash), Haxby (Thurgood), Pocklington, Kilnsea (Boult), Stanley (Charles), Newton-on-Ouse (Hawkins), Pickering (Metcalf), Withernsea (Couldwell), Worsborough Bridge (Whitaker), Sherburn, Broughton, Ayton (Lownsboro), Whitby (Halliday), Seaton Ross (Blackburn), Oldfield, Marton-le-Moor (Fawcett), Niddersdale (Storey), Hessle-on-Humber (Burton), Huddersfield (Inchbald), Brockholes (Varley), Cawood (Smethurst), Malton (Morris), Thirsk, Easingwold (Tyers), Hacktall (Grassham), Hebden Bridge (Gibson), Holderness (Dobree), Ilkley (Taylor), Pateley Bridge (Storey), Pontefract (Hartley), Rastrick (Kaye), Richmond (Harris), Tadcaster (Raine), Yeadon (Roebuck), Bedale (Wheldon), Burley (Liversidge), Hull district—Whixley and the Hammertons (Wright), Warmfield (Townsend), Grangetown (Elgee), Southbank (Vatch).

DISTRIBUTION.*—Throughout Africa, Europe and western Asia. [*M. styx*, which inhabits southern and eastern Asia, is treated by Rothschild and Jordan as a distinct species.] AFRICA: Azores (Godman), Madeira (Baker), Canaries (Speyer), Teneriffe (White), Cape Verde Island (*teste* Bartel), Mauritius, Réunion, Madagascar (Tring coll.), Natal (Boisduval), Eastern Caffraria (Wallengren), Durban† (Leigh), Pretoria (Distant), Transkei—Buntingville (Barrett), Somaliland (Holland), South Africa (Smith), Mozambique, Guinea (Speyer), Sierra Leone (Morgan), German southwest Africa (*teste* Bartel), Chinchoxo (*teste* Bartel), Gambia (Druce), Gaboon (Holland), northwest Morocco (Blackmore), Algeria—Oran (Oberthür), Bougie (Lucas), Tangier (Meade-Waldo), Collo, rare (Seriziat), Egypt (Granger *teste* Réaumur), Alexandria (Speyer). ASIA: Asia Minor, almost throughout—Smyrna, &c. (Staudinger), Syria—Marmarice on coast (Mathew), Haifa (Staudinger), North Persia—Gjas, Astrabad (Bienert). AUSTRO-HUNGARY: Trient, Bozen, Meran (*teste* Bartel), Taufers, Innsbruck (Weiler), Tyrol—Imst, very common (Hinterwaldner), Upper Austria—Linz district, rare (Himsl), Bucovina (Hormuzaki), Pressburg (Rozsay), Bohemia (Nickerl), Neu Saudec (Klemensiewicz), Stanislawow (Werchratski), Galicia (Nowicki), Cracow (Zebrawski), Brünn (Schneider), Hermannstadt (Czekelius), Eperies, not rare (Husz), Hungary—Zubercoz, Kocsócz (Vángel), Puj (St. Bordan), Gölnitz (Hudák), Hraszt, near Fiume (Mann), Lavantthal (Hofner), Upper Styria—St. Lambrecht (Kodermann), Salzburg, Kirchdorf, Vienna, Carlsbad, Prague, Lausatiau mts., Moravia—Mährisch-Trübau, rare, Brody, Trembowla, Stanislau, Hungary, generally common—Kaschau, Rosenau, Raab, Heveser and Zipzer Comitat, Temesvár, Mehadia, Debreczen, Transsylvania, Croatia—Zupanje, Bosnia—Dervent (*teste* Bartel), Fünfkirchen, Budapest (Aigner-Abafi), Istria, common—Rovigno, &c. (Hermes). BELGIUM: not common (Donckier), Namur district, sometimes common (Lambillion), Antwerp (Johnson), Virton, Cuesmes, Frameries, Cog-sur-Mer, Heure-les-Marche, Bioul, Anhée, Jambes (Derenne). BULGARIA: nr. Sophia (Bachmetjew), Rustschuk (Kowatschew), Schipka (Mische), Slivno (Haberhauer). CHANNEL ISLANDS: Guernsey, Alderney, Sark, common some years (Luff). CORSICA: not rare (Marshall). DENMARK: everywhere, but rare—Helsingör, Zealand Island, &c. (Bang-Haas). FINLAND: singly (Lampa). FRANCE: pretty common throughout (Berce), Aube (Jourdheuille), Brittany, abundant (Oberthür), Calvados (Fauvel), Douai (Foucart), Berry and Auvergne (Sand), Eure-et-Loir (Guénée), Haute-Garonne (Caradja), Meuse, Moselle and Meurthe dist., (Speyer), Gien (Abicot), Puy-de-Dôme, sometimes common, at others very rare (Guillemot), Morbihan (Griffith), Gironde, throughout (Trimoulet), Doubs—Chamars, common (Bruand), Aude—Carcassono (Mabille), Saône-et-Loire (Constant), Loire-Inférieure—Nantes, &c. (Bonjour), Paris district—Port Marly (Walker), Nainvilliers, Poitou (Réaumur), Seine-Inférieure (Viret), Indre, common (Martin), St. Quentin (Dubus), Deux-Sèvres (Maillard), Sarthe (Desportes), Bouches-du-Rhône—Marseilles, &c. (Siépi), Haute-Saône—Gray (Paris), Var—Hyères, Entrevaux, &c. (Powell), Cannes (Constant), Guyenne, Angers,

* Keferstein says (*Stett. Ent. Zeit.*, ii., p. 117) that he has "examples from Mexico, Java, and Cape of Good Hope, which show no appreciable difference from the European." Huwe, at the meeting of the Berlin Ent. Society, held November 23rd, 1899, exhibited a specimen that, he said, "came from Honduras, the forewings strongly marked with red-brown, the hindwings without bands." Can this species really fly from Africa to central America? Are the specimens rightly named? Have mistakes occurred as to their locality?

† It is remarkable that, living in or near Durban, from June, 1872, to April, 1875, and being keenly interested in the lepidoptera of the district, I never saw *M. atropos* in any stage. Natal is quite a home for the *Solanaceae*, whilst Daturas and *Physalis* are common wayside weeds, and Nicotianas are everywhere. Perhaps the thought that it is a recent addition to the fauna is not so improbable as may at first sight appear (Burrows).

St. Gilles (*teste* Bartel), Boulogne (Timins), Aix-les-Bains (Agassiz), Maine-et-Loire (Doré), Normandy—Les Damps, Pont-de-l'Arche, Basses-Pyrénées—St. Jean-de-Luz (Dupont), Josnes (Harrison), Agen (Laboulbène), Chartres (Marchand), Avignon (Caumont *teste* Réaumur). GERMANY : everywhere, but mostly rare (Heinemann), northwest Germany, almost everywhere (Jordan), Bremen, distributed, but rare, commoner some years (Rehberg), Prussia, everywhere but usually rare—Königsberg, Intersburg, Dantzig (Grentzenberg), East Prussia—Liebstadt, West Prussia — Hirschfeld, Elbing (Gauckler), Rhine Palatinate (Bertram), Giessen (Dickore), Lower Elbe district—Wandsbeck, Eimsbüttel (Zimmermann), Waldeck (Speyer), Erfurt (Keferstein), Zeitz-on-the-Elster (Wilde), Halle (Stange), Munich, not rare (Kranz), Rudolstadt (Meurer), Mecklenburg (Schmidt), Saxon Upper Lusatia, always rare, larvæ commoner in 1888 — Bautzen, &c. (Schütze), Dresden (Steinert), Thuringia—Mülhausen, Nazza, Urleben, Erfurt, Gotha, Arnstadt (Krieghoff), Lübeck (Paul), Silesia—Grünberg, Schweidnitz, Brieg, Breslau, &c. (Assmann), Upper Lusatia (Moeschler), Wurtemberg—Stuttgart, Ludwigsburg, very common 1846 and 1859, both very hot summers (Hoffmann), Ratisbon (Schmid), Pomerania, rare but sometimes commoner—Stettin, Pommerensdorf, &c. (Hering), Dessau, some years not rare, *e.g.*, 1847 (Richter), Alsace—Colmar, Hardt, near Mulhausen (Peyerimhoff), Wernigerode, rare and uncertain (Fischer), Brunswick, rare except in special years (Heinemann), Hanover, some years not rare (Glitz), Frankfort-on-Oder (Kretschmer), Eutin (Dahl), Lübeck (Paul), Charlottenburg (Bartel), Berlin district, somewhat rare (Pfützner), Hildesheim, rare (Grote), Ost-Sea coast—Wustrow (Bartel), Schwerin (Voelschow), Eutin, Barmen, Wald, Elberfeld rare, Wetterau, Cassel, Leipzig, Würzburg, Landshut, Kempten, Worms, Bingen, Nassau, Frankfort-on-Main, Wiesbaden, Wehen, rare, Büdingen, Grünberg — Oberhessen, Biedenkopf, Bavarian Palatinate (*teste* Bartel), Eisenach (Kühn), Offenbach (Göze), Weimar (Schröter), Chemnitz (Pabst), Baden — Constance, Freiburg, Lahr, Carlsruhe, not rare (Reutti), Coblentz (Unzicker), Mangfall district (von Gumppenberg). GREECE : Naxos, Attica (Staudinger). ITALY : throughout (Curò), Modena (Fiori), Monte Rotondo, Naples, Otranto, Sicily, frequent throughout (Minà-Palumbo), Monreale, near Palermo (Mann), Roman Campagna, Lombardy, Piedmont, Liguria (Calberla), Bologna (Cardano), Bordighera, Sardinia, Tuscany (*teste* Bartel). NETHERLANDS : all provinces, usually rare, some years common (Snellen), Breda, usually rather rare (Heylaerts), Zevenhuizen (Lechner), Limburg (Mauriss), Gröningen (Gavere), Apeldoorn (Voss). PORTUGAL (*teste* Bartel). ROUMANIA : generally distributed, Grumazesti, Costischa, Bacau, Husch, Jassy (Caradja), Dulcesti (Hormuzaki), Comanesti (Mann), Tulcea (Leon). RUSSIA : Baltic provinces, uncertain --Wolmar (Klengenberg), Edwahlen, Riga (Kawall), Altona (Teich), Koik, Reval (Huene), Arensburg (Wardenburg), Moscow govt. (Albrecht), southwest Caspian district—Lenkoran (Radde), Crimea (Melioransky), Lower Volga district—Saratov, Sarepta, &c. (Eversmann), Transcaucasia—Tiflis, Borjom, Lagodekhi, Lenkoran, Daghestan, Achty, Derbendt, Helenendorf (Romanoff), St. Petersburg (Erschoff), Gorki (Ballion), Livonia—Riga, &c., Kurland, Poland—Kamenez-Podolskii, Lubny, Poltawa, Jekatineroslaw, Charkow, Crimea—Aluschta, Noworossiisk (*teste* Bartel). SCANDINAVIA : rare, but occurring as far as Sydvaranger (Aurivillius), Lofoden Islands, a migrant (Petersen), Lappmark, &c. (Wallengren), Norway, as a visitor at many places (Siebke). SPAIN : Andalusia—Granada, Cadiz (Rambur), Galicia (Macho-Velado), Malaga (Speyer), Barcelona, Martaró, Calella (Cuní y Martorell), Catalonia (Martorell y Peña), Chiclana (*teste* Bartel), Bilbao (Rössler), Gibraltar, occasional (Walker). SWITZERLAND : distributed throughout from Basle and Schaffhausen to Genf and the Upper Engadine—reaching in the Upper Engadine a height of 5000ft., and in Gadmenthal to 4300ft (Frey), Weissenburg (Huguenin), Grisons (Killias), Bechburg (Riggenbach-Stehlin), Chiasso (Knecht), Zürich, rare (Nägeli), Zürichberg (Dietrich), Cour-sous-Lausanne (Chaumette), Berne (Benteli). TURKEY : Gallipoli (Mathew).

APPENDIX

MIMAS TILIÆ, Linné (Vol. iii., p. 399).

[Page 411.] DEVELOPMENT OF THE MARKINGS OF THE LARVA OF MIMAS TILIÆ. — *First instar:* The young larvæ emerge after an oval period of 14 days; they are of a light green colour, are conspicuous for the great length of the caudal horn (which is nearly half as long as the body); this horn is likewise of a light green tint at first, but becomes dark violet in the course of an hour; no trace of markings can be detected at this stage. The larvæ rest on the largest vein on the underside of the lime leaves, and, in this situation, have the same form and colour as the leaf vein. They moult in from 4-5 days. *Second instar:* On each side of the segments 4-11, there now appear 7 oblique whitish stripes on a somewhat darker green ground; these slope in the direction of the caudal horn; owing to the transparency of the skin, a dark green dorsal line appears in the position of the underlying dorsal vessel, the green contents of the alimentary canal being distinctly visible through the absence of adipose matter in the tissues; the larvæ possess also a fine whitish subdorsal line, which extends from the horn to the head; the horn at this stage becomes black with a yellowish-red base. In 6 or 7 days the second moult takes place. *Third instar:* The oblique stripes now appear darker and the subdorsal line disappears. The third moult takes place after another period of 4 or 5 days. *Fourth instar:* There now commences a dimorphism (better perhaps designated as variability since the two extremes are connected by transitional forms) in the larvæ. (1) The majority of the larvæ have, as in the preceding stage, pure white, oblique stripes. (2) Many, however, possess a blood-red spot on the anterior side of the stripes, this spot showing all gradations in size and depth of colour between maximum development and a mere trace. *Fifth instar:* In this, the last stage, the red spots become more strongly pronounced. Among 80 caterpillars from one brood there were about 20 without any red, whilst the remainder were ornamented with more or less vivid blood-red spots, often large and irregular in form; in some specimens the spots had become drawn out into lines (this variety is figured by Rösel) forming a coloured edge to the oblique white stripes, similar to that possessed by the larva of *Sphinx ligustri*. The caterpillar is thus represented in many figures, but generally the coloured stripe is made too regular, as, in reality, it is always irregularly defined above, and never so sharp and even as in *Sphinx ligustri*. The character is here obviously not yet perfected, but is still in a state of development (Weismann, *Studies in the Theory of Descent*, transl., pp. 233-236).

SMERINTHUS OCELLATA, Linné (Vol. iii., p. 424).

[Page 436.] DEVELOPMENT OF THE MARKINGS OF THE LARVA OF SMERINTHUS OCELLATA.—*First instar:* The newly-hatched larvæ are

entirely without markings, but, as in the larvæ of *Amorpha populi*, the markings are formed during the first stage, and are distinctly visible before the first moult. The long caudal horn is of a red colour. The first moult takes place in two or three days. *Second instar:* The length is now 1cm.; the seven beautiful oblique white stripes and the fine white subdorsal line are more strongly pronounced, the latter becoming broader in front; they differ from those of *A. populi* in having the oblique stripes united in the dorsal line. The second moult occurs after another three days. *Third instar:* There is no important change, only the fine subdorsal line becomes somewhat fainter. The third moult takes place four days later. *Fourth instar:* The oblique stripes remain as before, but their upper portions now stand on a somewhat darker green ground colour, whilst the subdorsal line vanishes, leaving distinct traces only on the three or four front segments. The fourth moult follows after a period of seven days. *Fifth instar:* Scarcely any difference in marking occurs, only small differences in coloration become perceptible on the head and horn, these changing to bluish. Specimens occur, although but rarely, which show, in this last stage, red spots in the vicinity of the oblique stripes, just in the same manner as with larvæ of *A. populi*, in which species, however, they occur more commonly. I only once found an adult larva of *S. ocellata* possessing reddish-brown spots above and below the oblique stripes, exactly as in one of the specimens figured by Rösel (*Insecten-Belustigungen*, suppl. pl. xxxviii., fig. 40) (Weismann, *Studies in the Theory of Descent*, transl., pp. 240-241).

AMORPHA POPULI, Linné (Vol. iii., p. 460).

[Page 469.] *Amorpha populi* ab. *subflava*, Gillmer, "Illus. Zeits. für Ent.," vii., p. 375, figs. 1-2 (1902).—Die ganze Oberseite bedeckt ein gleichfarbiges Thongelb (von der lichten Farbe einer frisch gebrochenen Ofenkachel) ohne alle Zeichnung nur der Basalfleck der Hinterflügel ist schwach rostfarben und in seiner sonst üblichen Ausdehnung etwas beschränkt. Die Rippen zeigen eine ganz gleichfarbige Beschuppung, ein Mittelfleck ist nicht sichtbar und eine helle Teilung der Flügelspitze nicht vorhanden. Die Saumlinie der Flügel tritt mit einem etwas tiefer bräunlichgelben Tone hervor. Die Unterseite aller Flügel ist gelbgrau, ohne alle Zeichnung; die Rippen heben sich mit ganz schwach bräunlichem Tone daraus ab. Fühler gelblichweiss. Thorax gelbgrau. Hinterleib hell bräunlichgelb, mit helleren Ringteilungen. Das Stück gehört der zweiten Generation an und schlüpfte in Schlesien. Es ist durch Fig. 1 dargestellt (Gillmer).

This aberration, described above as having "the upper side unicolorous clay-yellow without markings, only the basal patch of the hindwings pale rust-red and somewhat more restricted than usual, the nervures concolorous, the central spot obsolete, the light apical line absent, the marginal line somewhat deeper-tinted, brownish," is evidently an extreme yellowish form of our ab. *pallida*, which is described (*antea*, iii., p. 469) as "whitish-grey, often with a faint yellowish tinge, usually with ill-defined markings." This was given as a group name to include all those pale (whitish-grey and yellowish-grey) examples with no markings or ill-defined ones. The *tremulae* of Borkhausen is the extreme development in one direction (whitish-grey with no markings), *subflava* the extreme in the opposite direction (unicolorous clay-yellow almost without markings) whilst Glaser's *tremulae* (*Oberhess. Gesell. Nat.*, iii., p. 53), which is described as smaller and lighter than *A. populi*,

"white-grey mixed with weak rust-yellow and with weaker markings," represents another colour tint of this obsoletely-marked form. That Glaser, in 1863, redescribed *tremulae* as "the small light aberration of greenish-white ground colour and with weaker markings" (see *antea*, iii., p. 471), points somewhat to the fact that, apart from the mere tint of the ground colour, he probably intended to include in his ab. *tremulae* all the pale obsoletely-marked aberrations of this species known to him, although he does not say so. It appears to us that the ab. *tremulae*, Bkh., ab. *tremulae*, Glas., and ab. *subflava*, Gillm., are separable elements of our more comprehensive ab. *pallida*.

[Page 469.] *Amorpha populi* ab. *decorata*, Schultz, "Berl. Ent. Zeits.," xlvii., p. 288 (1902).—Maculis alarum anticarum ferrugineis aeque ac in basi posticarum. Auffalend dadurch, dass rostrote Flecken (von der Färbung des Hinterflügel-Wurzelfeldes) auf den Vorderflügeln sich deutlich von der lichtgrauen Grundfarbung abheben. Upperside: Forewings of a light ashy-grey (not red-grey) ground colour, with a broad dark grey median area, which is sharply marked off from the paler basal area . . . . In the median area of both forewings along the inner margin, and reaching to nervure 3 is a patch of rust-red colour, like that of the basal patch of the hindwings, which, towards the base and outer margin, stands out in stronger relief than in the intermediate portion of the wings. Hindwings grey, with a broad rust-red blotch at the base, with a distinct dark wavy line interrupted by the pale nervures. Thorax, abdomen and antennæ grey. From Hungary. The example mentioned by Treitschke (*Die Schmett.*, x., p. 141) as being found by Kollar, and which had a rust-red marking on one forewing, appears to be an asymmetrical transition to the new aberration (Schultz).

[Page 482.] DEVELOPMENT OF THE MARKINGS OF THE LARVA OF AMORPHA POPULI.—*First instar:* The newly-emerged larvæ are 6.5mm. in length, without markings, of a light greenish-white hue, the large head and long caudal horn being of the same colour, the posterior boundary of the segments appearing as a light shining ring (pl. vi., fig. 55). The characteristic markings of the genus appear on the following day without the occurrence of any moult; 7 oblique white stripes arise from near the dorsal line, and extend along the sides in a direction parallel to that of the horn. On the front three segments they are represented only by three small white spots (fig. 56); the larva likewise possesses a marking, of which the adult species of the genus retain only a trace, *viz.*, a well-developed, pure white, subdorsal line, which is crossed by the six anterior oblique stripes, and, uniting with the upper part of the 7th, extends to the caudal horn. The larva moults after five days. *Second instar:* The larvæ are now 1·4cm. in length. Only unimportant changes of marking are connected therewith. The subdorsal lines lose much in thickness and definition, and the first and last of the oblique stripes become considerably broader than the intermediate ones (fig. 57). The green ground colour, and also the stripes, acquire a yellowish hue. On the other hand there occur changes in form. The head, which was at first rounded, becomes of the characteristic triangular shape, with the apex upwards, common to all the species of the genus, and, at the same time, acquires two white lines which unite above at the apex of the angle; the shagreening of the skin now also takes place, and the red spot at the base of the horn is formed. There appears to be at this stage a general tendency for the suffusion of red, the thoracic legs also becoming of this colour. The second moult occurs after 6 or 8 days. *Third instar:* The marking only changes to the extent of the sub-

dorsal line becoming still more indistinct; this line can now only be recognised on the front three segments in a few individuals, whilst, in the majority, it is completely absent; sometimes the ferruginous red spots on the oblique stripes now appear, but this character is not completely developed till the 5th stage. Out of about 90 examples, in which I followed the entire development, only one possessed such spots, and these were situated on both sides of the 6th segment. The third moult takes place after another period of six days. *Fourth instar:* There is no change of marking from the previous instar. *Fifth instar*:* The adult larva does not differ in marking to any considerable extent from that of the preceding stages. The first and last stripes do not appear larger than the intermediate ones, as the latter now increase in size. Many specimens were entirely without red spots, in others they were present, but were small and inconspicuous, whilst in others again there were two spots, one above the other, of a vivid ferruginous-red, these coalescing in some cases, and thus forming one spot of a considerable size. I have never seen these spots formed into a regular linear coloured border to the white oblique stripes, as occasionally happens in the larva of *M. tiliae* (Weismann, *Studies in the Theory of Descent*, transl., pp. 236-239).

HEMARIS TITYUS, Linné (Vol. iii., p. 528).

[Page 529.] *Hemaris tityus* var. *alaiana*, Roths. and Jord., "Revis. of Sphing.," p. 451 (1903). *Fuciformis*, Grum-Grsch., "Rom. Mém. Lép.," iv., p. 514 (1890).—♂ ♀. Black belt of abdomen much shaded with luteous hairs, tail with scarcely any luteous hairs; thorax and posterior abdominal segments less bright yellow than in *H. tityus*. Border of forewing broader than in the other form, as broad between R3 and M, as this cellule is wide at end; crossveins with an obvious bar which is nearly as prominent as in *H. affinis*; base of hindwing above and below less yellow than in *H. tityus*. A more generalised form than the ordinary *H. tityus*. Hab: Alai Mts. In the Tring Mus. 1 ♂ (type), 1 ♀, ex coll. Grum-Grschmailo (Rothschild and Jordan).

[Page 531.] ONTOGENY OF LARVA OF HEMARIS TITYUS.—*First instar* (larvæ hatched July 10th, 1902, described July 12th): The larvæ are somewhat grown in the first stadium 4·75mm.—5·5mm. in length, rather stout and of uniformly cylindrical shape (similar to a young Eumorphid larva). Colour white with a slight greenish tinge, the body semitransparent-looking, a dark mass (probably food in alimentary canal) within the body showing through the skin. The most distinctive feature of the larva is the large and very widely forked black hairs. Head rounded, bearing a few long black tapering hairs with simple (not bifid) tips. The prothoracic scutellum bears apparently simple tapering hairs which are, however, really slightly notched, as also are the terminal setæ on the caudal horn (i of the 8th abdominal); all other dorsal and lateral hairs, with the exception of the anal, and those on tubercle iv of the 7th abdominal (which is pale in colour and simple unforked) are black and widely forked, *i.e.*, Y-shaped; the setæ spring from pale brown chitinous tubercular bases. The dorsal tubercles i and ii of the meso- and metathorax have their bases conjoined so as to form an oval, twin, cone-shaped tubercle set obliquely to the median

* Compare *anteà*, vol. iii., pp. 478 and 479. Bacot's examples moulted 3, Hellins' examples moulted 4, times.

line of the larva, the outermost hair being to the front; iii is a twin-haired tubercle on the meso- and metathorax. On the abdominals, i and ii are set trapezoidally, iii is supraspiracular, iv is subspiracular and v prespiracular (except on the 1st and 8th abdominal segments where it is definitely below the level of the spiracle and set on the lateral flange in front of iv). On the abdominal segments 2—7, tubercle v, although well up to the level of the spiracle and towards the anterior margin of the segment, is set on the lateral flange, but the flange itself is curved up at the front of the segment. [This fact has a considerable bearing on the vexed question of the homology of the prespiracular tubercle in other Sphingid larvæ and would appear to be really tubercle v forced up out of its normal place.] The hairs themselves are very slightly thorned (or of uneven thickness) at long intervals and the forks are longer than the undivided stem. The skin-surface is smooth, without secondary hairs. The caudal horn has a slightly brownish tinge especially at the base, and the junction between it and the body is sharply marked and gives it a shrunken appearance; it is short, less than the thickness of the larval body in length, and the minute hairs or bristles with which it is covered are too small to be clearly distinguished unmounted, but apparently they are slightly forked at the tip. The spiracles occupy a somewhat anterior position; on abdominal segments 1-6 they are very small, much smaller than the tubercular plates, but on abdominal segments 7 and 8 they are very much larger, nearly as large as the tubercles and show up clearly because they are white surrounded by a narrow black oval rim. The subsegments are not very clearly marked, there appear to be 5 each to the meso- and metathorax and 8 to the abdominal segments. *Second instar* (July 18th, preparing for the second moult): Length 9·4 mm. The usual Sphingid change takes place at the first moult; the primitive tubercles with their large black forked hairs have disappeared, and are replaced by a dense growth of fine secondary hairs or bristles, colourless or of a pale green tint; these are forked at the tip but are very slightly so in comparison with the setæ arising from the primary tubercles in the first instar. The bases of these secondary hairs are slightly raised and are usually pale yellow or white and surrounded by a whitish speck; the position of the primary tubercles is shown, at any rate in some instances, by a slightly longer hair rising above the general coat. The hairs on the head, now much more numerous, are fine bristles, some of which are slightly notched at the tip and of dark colour; on the scutellum also the same change in the hairs is observable, some of them appearing to be very slightly forked or notched at the tip. The scutellum itself is prominent and its surface rough. The larva still has the even cylindrical appearance of a young Eumorphid larva, thus contrasting markedly when compared with a young Amorphid larva. There are eight subsegments on the abdominal segments, but there is a marked tendency for the first three subdivisions to form a single large subdivision in the Eumorphid manner. The caudal horn is short and conical, tapering considerably, the apex bearing two long hairs (which, in the specimen examined, cross each other near the tip). The horn is also covered with a coat of fine bristles that are but little, if at all, notched at the tip; there is not the same sharp line of separation between the body and horn in this stage. The colour

is still green with a yellowish ring at the junction of the segments where the skin overlaps; a dark (? structural) mediodorsal line, and a broad white subdorsal band (of the *Sesia stellatarum* pattern) running up to the base of the horn. The caudal horn itself has a pink stripe up the front and back and is entirely crimson at the tip, but is whitish on the sides from the base upwards for more than half its length. The spiracles are whitish or pale pink bordered by a black rim. There are, as yet, no lateral or spiracular bands, nor oblique stripes, but the larva is speckled with the white bases to the hairs. The general appearance of the larva is Eumorphid, but the coat of fine bristles with their forked tips gives the portion viewed with a strong lens an Amorphid appearance. [The most noticeable larval habit at this time is that of dropping without using a thread; the larvæ appear to hold on very loosely and to drop at the slightest touch or disturbance; no silk is used even when the larvæ are about to moult.] The ventral area is dusky and, after the next moult, becomes very dark olive-green, so dark that, a a casual glance, the colour gives the impression of black. *Third instar:* The larger of two larvæ in this instar is quite 12·5mm. in length, or, including the horn, which projects somewhat, 15mm. It is less evenly cylindrical, and has, consequently, lost much of its Eumorphid appearance; the 2nd, 3rd, 4th, 5th and 6th abdominal segments being larger, especially the 3rd, 4th and 5th, the larvæ taper slightly to the head, and more noticeably to the base of the caudal horn. The horn is longer, larger at its base, tapers to a point, is stiff, and has a backward curve. The colours are much as before, but brighter and with more prominent white specks, whilst the spiracles are situated in dark red oblique slashes, the slope of the latter being from head to anus; these slashes occur on abdominal segments 1-7, and are strongest on the segments that bear the prolegs. The secondary hairs are now shorter and smaller but still distinctly forked at the tip, the smaller dark-coloured and without marked bases, the longer and paler hairs with marked mammillary bases of an opalescent white colour, the latter are fewer in number, about 1 in 3; the larger mammillary-based hairs are situated on the top of the subsegmental ridges and exhibit the normal 8 rows to each abdominal segment. There is no marked tendency now for the first three subsegments to coalesce so that the Eumorphid characters would appear to be waning and the Amorphid to be increasing. The shorter hairs on the head and on the scutellum are still notched at the tip, the longer ones being simple, but this difference is not maintained on the body-segments, where the longer ones are, if anything, the more noticeably forked, the smaller dark hairs apparently representing a dwindling phase of this character. [This is suggestive of the change which takes place in Amorphid larvæ after the 1st moult, whilst the same accentuation of a portion of the bristles of the 1st instar occurs, but the hairs of the larva of *H. tityus* are now as numerous as those of Amorphid larvæ in the 1st instar, and larger proportionally, the forking being much more noticeable, although, of course, bearing no comparison with the forked character of the primary hairs which the larva of *H. tityus* has in its 1st instar when the forks are longer than the stalk of the hairs. As regards the development of secondary

hairs, the 2nd instar of the larva of *H. tityus* represents possibly a more primitive condition than the 1st of an Amorphid larva, whilst the 3rd instar of *H. tityus* is but little in advance of the 1st of *Smerinthus (ocellata)*, and certainly not so advanced as the 2nd of *Amorpha (populi)* where the hairs are already waning in favour of the mammillary bases.] Traces of the oblique stripes (anus to head slope) above the subdorsal line are already observable on the middle abdominal segments. *Fourth instar* (July 27th): The larva is now 1·125in.-1·25in. in length, including the caudal horn, which slants slightly upwards, but has a downward curve at its point, making it appear somewhat horizontal. The shape is much as in last instar, but the larva is a little plumper, not tapering so much towards the head, nor showing so marked a tendency to narrow at the 1st and 2nd abdominal segments, although it still tapers somewhat to the caudal horn. The subsegmental divisions are fairly clear; and there is still a slight tendency for the first 3 subsegments to unite into a single subdivision to be observed if carefully looked for. The colours and markings as before but the crimson slashes, both above and below the subdorsal line, are stronger; below the subdorsal, across the spiracles on abdominal segments 2 to 7, they are definite stripes (with head to anus slope) faintly bordered by pale yellow or yellow-green, whilst, on the 1st and 8th abdominals, they are still mere spots; above the subdorsal they form very short streaks (with a tendency to slope in the reverse direction) on the 2nd to 7th abdominals, and small spots on the 1st and 8th; the greater part or whole of these upper streaks is on the first three subsegments.* The caudal horn is dark purple. The venter is purplish-black, this tint shading off into the green lateral area and showing pinkish at the junction, the prolegs being shaded with this colour. The head, pro- and mesothorax are more of an apple-green tint in contrast with the yellower green of the remainder of the body. The legs are pinkish. The spiracles brown centrally, white at either end, surrounded by a black chitinous rim. The mammillary hair-bases are still opalescent white, and the hairs very much longer than is usual in Sphingid larvæ at this stage; they are still slightly forked at tip and this gives the larva a very soft furry appearance, resembling that of an Amorphid larva in its first instar, when seen under a lens. The hairs on the head and scutellum are black, and not noticeably, if at all, forked; those on the body are, for the most part, pale and clearly forked and more numerous than in any other Sphingid larva known to me, at this stage, there being more than one row on a subsegment; the mammillary bases are of course not so large as those of the Amorphid larvæ but are still quite prominent when viewed with a lens. *Fifth instar* (August 5th, adult): 1·5ins. long at rest, 1·75ins. when crawling, $\frac{5}{16}$in. in girth, and $\frac{3}{8}$in. in height, the body slightly raised when at rest. In shape the larva is short, stout, and plump, cylindrical and tapering gradually towards head and anus, more gradually towards anus and slightly more rapidly towards head, which is rather larger than is

* One of the special points about the larva of *H. tityus* is the fact that it combines both the forward sloping and backward sloping series of oblique stripes in its scheme of coloration, and although the upper series is less distinct and more confused than the lower, the tendency is clear enough (Bacot).

usual in Eumorphid and Sesiid larvæ. The horn is raised at a greater angle than in the last instar, now nearly 45°, is but little curved, about ·25ins. long, tapering gradually to a point and appearing very thorny. The head is rounded, only slightly inclined to be tall, of a darker and duller green than the body which is apple-green in hue. The crimson or dark pink markings are very much increased in this stage (in the larva examined). The horn is dark crimson or purple; the ventral area purplish or livid pink. The spiracles are still composite in colour, orange in the central area, white at the ends, surrounded as usual by a black rim. [The scheme of coloration matches well with the coloration of its foodplant, as scabious leaves frequently show shading and blotching of dark crimson or purple.] There are faint traces of a dark mediodorsal line, the crimson slashes surrounding the spiracles are considerably strengthened, whilst those above the subdorsal line are increased to a continuous band with serrated upper edge, the serrations rising sharply upwards at the front of the segment, the apex of each stripe being on the second subsegment and it gradually tapers to the posterior margin of the segment. The subdorsal line (no longer a band), immediately below the upper crimson markings, is now faint and dull forming a mere border to the serrated crimson band. The hairs are still long for those of a Sphingid larva*; the raised bases are as before, but the hairs now appear to taper to a point, and I observe none forked or notched at the tip. The horn still ends in two fine hairs of the normal secondary type. The incision between the 3rd and 4th subsegments is slightly more marked than between the other subsegments (Bacot).

SESIA STELLATARUM, Linné (Vol. iv., p. 4).

[Page 13.] ONTOGENY AND VARIATION OF LARVA OF SESIA STELLATARUM.—*First instar* †: When the larvæ emerge they are only 2mm. in length, and are at first yellowish, but soon become green, set with small single bristles, and they possess a short greenish caudal horn, which afterwards becomes black. The head is greenish-yellow. The young larvæ are entirely destitute of marking (pl. iii., fig. 1). *Second instar:* The first moult takes place after four days, the larva now acquiring the marking which it essentially retains to pupation. Fine white subdorsal and spiracular lines appear, and, at the same time, a dark green dorsal line, which, however, does not arise from the deposition of pigment, as is generally the case, but from a division in the folds of the fatty tissue along this position (pl. iii., fig. 2). The colour is now dirty green in all specimens, the skin being finely shagreened. *Third instar:* The second moult, occurring after another period of four days, does not bring any change of marking, the colour only being

* Normally the hairs on adult Sphingid larvæ are so reduced as to make the larvæ appear quite naked, although examination with a strong lens reveals the fact that hairs are present although exceedingly reduced in size.

† The eggs from which these larvæ were reared were obtained by placing a captured ♀ of *S. stellatarum* in a capacious breeding-cage, in the open air. The moth hovered about over the flowers and laid its small, grass-green spherical eggs (partly when on the wing) singly, on the leaves, buds and stalks of *Galium mollugo*, 130 being obtained in three days. The deposition of eggs was accomplished by the insect laying hold of the point of a twig with its legs during flight.

somewhat darker. Length 12mm. *Fourth instar:* The third moult (after another four days) likewise brings only a change of colouring, which is of such a nature that the caterpillar becomes dimorphic. At the same time that peculiar roughening of the skin takes place, which has been designated as shagreening. The colour is now (1) light grass-green in some specimens, (2) dark green in others. In these last, the subdorsal line is edged above with dark brown, and the spiracles are also of this colour. Length 17mm. *Fifth instar:* Four days later the fourth moult takes place, and the dimorphism then becomes a polymorphism, in which five chief types can be distinguished:

1. Light green (pl. iii., fig. 7); dorsal line blackish-green, strongly marked; subdorsal line broad, pure white, edged above with dark green; spiracular line chrome-yellow; horn black, with yellow tip and blue sides; spiracles blackish-brown with narrow yellow border; legs and extremities of prolegs vermilion-red.
2. Blackish-brown (pl. iii., fig. 6); head and prothorax yellowish-brown; markings the same as 1.
3. Blackish-green or greenish-black (pl. iii., figs. 10-11); subdorsal line with blackish-green border above, gradually passing into a light green ground colour; spiracular line chrome-yellow; head and prothorax greenish-yellow.
4. Light green (pl. iii., figs. 4 and 12); dorsal line quite feeble; subdorsal broad, only faintly edged with dark green; subspiracular line faint yellowish; head and prothorax green.
5. Brownish-violet (pl. iii., fig. 8); the black dorsal line on a reddish ground either narrow or broad.

From these five varieties we see that the different types do not stand immediately next one another; they are, in fact, connected by numerous transitional forms, the ground colour varying greatly, being dark or light, yellowish or bluish (compare figs. 4, 5, 7 and 12). The markings remain the same in all, but may be of very different intensities. The dorsal line is often only very feebly indicated, and the subdorsal line is frequently but faintly edged; the latter is also sometimes deep black above and bordered rather darkly beneath, the sides then being of a dark green, often with blackish dots on the yellow spiracular line (fig. 5), this likewise being frequently edged with black. Only the horn and legs are alike in all forms. The green ground colour passes into blackish-green, greenish, or brownish-black, and again from reddish-brown to lilac (fig. 3), this last being the rarest colour. We have here no sharply distinct forms, but five very variable ground colours connected by numerous intermediate modes of coloration. I am in possession of an observation which tends to show that the different colours have, to a certain extent, become fixed. I found a brown caterpillar, the front five segments of which were light green on the left side, and the fifth segment brown and green mixed (pl. iii., fig. 9). Such parti-coloration can evidently only appear where we have contending characters which cannot become combined. . . . From this observation, I conclude that some of the chief varieties of the larva of *stellatarum* have already become so far removed from one another that they must be regarded as intermediate fixed forms, the colours of which no longer become fused together when they occur in one individual, but are developed in adjacent regions. Other facts agree with this conclusion. Thus, among the 140 adult larvæ which I bred from the batch of eggs above mentioned, the transition forms were much in the minority; there were 49 green

and 63 brown larvæ, whilst only 28 were more or less transitional . . . . Immediately before pupation all the larvæ, both green and brown, acquire a lilac coloration. The fifth stage lasts seven days, and the whole larval development 23 days, the period from the deposition of the egg to the appearance of the moth being only 31 days. . . . This polymorphism is not in any way connected with a more advanced development of the markings, since the larva of *S. stellatarum* shows, in this respect, a very low state of development. This species displays only two stages: (1) Complete absence of all markings. (2) A simple subdorsal with dorsal and spiracular lines. We must, therefore, admit that the phyletic development of the markings has for a long time remained at a standstill, or, what expresses the same thing, that the marking which the adult larva now possesses is extremely old (Weismann, *Studies in Theory of Descent*, transl., pp. 246-252).

[Page 14.] VARIATION OF PUPA OF SESIA STELLATARUM.—The pupa varies but very slightly; the ochreous-yellow ground colour sometimes passes into reddish, and sometimes into greenish; the rather complicated blackish-brown marking of streaky lines is very constant, especially on the wing-portions, being at most only more or less strongly pronounced. The minute colour variations of the pupa, therefore, have no connection with the colour of the caterpillar, both green and brown larvæ furnishing sometimes reddish-yellow and sometimes greenish-yellow pupæ (*loc. cit.*, pp. 252-253).

EUMORPHINÆ (Vol. iv., p. 36).

[Page 49.] TURNERIA hybr. AMELIA, Feisth., "Bull. des Sci. Nat.," xi., pp. 162-163 (1827); Roths. & Jord., "Revis. of Sphing.," p. 729 (1903).—At first sight, *Sphinx amelia* resembles a faded example of *hippophaes*, but one finds on closer study that the general appearance is rather that of *vespertilio*, in fact, it seems to be a hybrid between these two species, but an examination of the larva leaves no doubt that it is a distinct species. The size is that of an ordinary *hippophaes*, and the shape of the wings is the same; above, the forewings are of a pale grey with the posterior border darker and ornamented with a band the whole length of the wing; the band widens from the apex almost to the middle and the extremity of the lower edge. The margin is edged with yellowish-white but becomes tinged with slaty-blue as it approaches the body. There is no black spot in the middle of the wing as in *hippophaes*, but an indistinct mark. The hindwings are rosy between two black bands, nearly equal in width. The rosy band is much wider than in *hippophaes*; the black posterior band is furnished with a narrow yellowish-white edge; there is, as in *hippophaes*, an orbicular space near the body, between the two black bands, but instead of being white it is rosy. On the underside the forewings are of an ashy-rose, slightly tinged with bluish at the extremity; one notes on the underside, as on the upperside, the same absence of the little black line which is found in *hippophaes*. The body is of a bluish-grey, with the sides of the anterior half of the abdomen white, and cut transversely by two small black bands. The legs are of a yellowish-white, the inner part nearest the body is furnished with bluish scales. The trunk is similar to that of *hippophaes*, *i.e.*, a shiny yellowish-brown. The antennæ are whitish above and greyish below. *Larva*: When the larva attains its full growth it measures $2\frac{1}{2}$ins. in length; it is of a dark green-brown and furnished with sienna-coloured points, ranged along the body segments. The head is golden-yellow, having a wide cross of the same colour on the 1st segment. The stigmata are rosy and decrease in size from the anus to the head so that the 5th is scarcely visible. The venter is of a pale lilac, bordered with a rosy-white line which separates in all its length the general colour of the upperside of the body from that of the venter. The prolegs and true legs are of a beautiful rose colour, the latter are a little the darker. The anal horn of this larva is shorter, lightly marked, of a brown-green above and rose on the sides. It is to be observed that this

larva bears no resemblance in colour and arrangement of spots with that of *hippophaes*. It lives solitarily on the leaves of *Epilobium augustifolium;* it was found for the first time on July 11th, 1825, on the banks of the Drac, a torrent near Grenoble, by Madame Amélie Vattier. The husband of this lady found many the next year at the same time, and gave them to Mr. Feisthamel, who described the larva as well as an imago that emerged towards the end of August. Mr. Prévost Daval also found many larvæ at the same place and at the same time, but he, too, reared only one specimen. These two are the only ones known (Feisthamel).

This hybrid is evidently the same as *vespertilioides*, Bdv. (*anteà* p. 49). Both Feisthamel and Boisduval appear to have described the insect in the same year from specimens reared independently from larvæ found in the same locality. Boisduval seems to have published his description in March, 1827, whilst the date of Feisthamel's publication appears to be June, 1827, but neither is at all certain, nor does either author say a word to show that he knew anything about the other's records and experiences.

PHRYXUS LIVORNICA, Esper (Vol. iv., p. 147).

[Page 149.] *Phryxus* var. *livornicoides*, Lucas, "Proc. Roy. Soc. Queensland," iii., pp. 73-74 (1891); Roths. & Jordan, "Revis. of Sphing.," p. 734 (1903). ? *Australasiae*, Tutt. "Brit. Lep.," iv., *anteà* p. 149 (1903).—♂ 55mm., ♀ 75mm. *Male:* Head creamy-drab, with a patch of olive-fuscous on crown and narrowing along face. Palpi creamy-drab, bordered with fuscous. Antennæ olivaceous-creamy-drab on undersurface. Thorax olive-fuscous, with a creamy-drab line anteriorly over dorsum, and laterally nearly as far as forewings. Abdomen olive-drab; base of segments with a band of creamy-drab, broader on fore segments, narrowing to a line in posterior segments; each line banded with a short black stripe on either side of dorsum; the two anterior lines are covered laterally with a broad band of black. Forewings triangular, costa straight, rounded at apex, hindmargin rounded, creamy-drab, with two long bands of dark olive-fuscous, crossed by bands of ground colour along the veins; costal line light olive-fuscous; space between costal line and 1st band lighter fuscous; 1st band from entire base of wing parallel to costa, narrowing at $\frac{2}{3}$ to a point just before apex; the 2nd band from a base $\frac{1}{2}$ to $\frac{6}{7}$ inner margin, gradually narrows parallel to hindmargin to a point at apex; an olive-fuscous hindmarginal line; cilia light drab. Hindwings fuscous-black at base, rosy-pink in middle third, and with a broad fuscous-black band near, but not touching, hindmargin; hindmarginal line creamy-grey; cilia as forewings. One specimen; Toowoomba. *Female:* Head and thorax olive-fuscous with a white drab line from face on either side along base of antenna, and along side of dorsum giving off a bunch of white-drab hairs at base of forewing; a white-drab line midway between bases of antennæ, early dividing into two, and narrowly diverging on either side of centre of dorsum; a line to outer side of this on either side, thus being 6 lines on thorax similar to *D. linearis* (sic), Fab., of America. The abdomen is rich chocolate-fuscous, with lines of segments yellow-fuscous, each line crossed by a narrow bar of black immediately on either side of dorsum, and laterally by a broad bar of black. Wings as ♂. One specimen, Rockhampton. This species differs from *D. livornica*, Esp., in lacking the white stripes on thorax in ♂, in lacking the row of white dots and stripes on abdomen, aud in the different ground colour of wings. The markings on thorax and abdomen are quite different and vary in the sexes (Lucas).

This appears to be possibly the variety which we have named *australasiae*, n. var. (*anteà*, p. 149). The latter name, therefore, if this were so, would fall as a synonym of *livornicoides*. Our variety, however, has the normal thoracic markings of *P. livornica*, and has nothing to do with *lineata*.

HYLES EUPHORBIÆ, Linné (Vol. iv., p. 202).

Rothschild and Jordan (*Revision of the Sphingidae*, pp. 715 *et seq.*) have an omnibus species *euphorbiae*, which they subdivide into 10 subspecies, 3 local forms, and 4 aberrations. Most of the subspecies are by other authors considered as species, and are—*dahlii*, Hb.-Gey., *tithymali*, Bdv., *mauretanica*, Staud., *euphorbiae*, Linn., *conspicua*

Roths. and Jord., *siehei*, Püngeler, *centralasiae*, Bienert, *robertsi*, Butl., *nervosa*, Roths. and Jord., *costata*, Nordm. The three recognised local forms are *paralias*, Nick., *rubescens*, Garb., *grentzenbergi*, Staud. The aberrations noted are *helioscopiae*, Selys-Longch., *lafitolii*, Thierry-Mieg, *esulae*, Bdv. (*nigrescens*, Roths. and Jord.) and *restricta*, Roths. and Jordan. We have in our account of *H. euphorbiae* (*anteà*, pp. 202 *et seq.*) entirely excluded *dahlii*, *tithymali*. *mauretanica*, *robertsi* and *costata* as being separate species; *conspicua*, Roths. and Jord., comprises part of our var. *lathyrus*, Walk. (see p. 210); *siehei*, Pung., has been described since this part of our work was printed; *centralasiae*, we have treated as a variety of *euphorbiae*; *nervosa* was unknown to us. We are inclined to think that *conspicua*, *siehei* and *centralasiae* are eastern forms (*i.e.*, varieties or local races) of *H. euphorbiae*, but we still believe that, in the ordinary sense, *dahlii*, *tithymali*, *mauretanica*, *robertsi*, *nervosa* and *costata* are entitled to specific rank. The following notes, therefore, are explanatory of, or supplementary to, those already published in our account of the species (*anteà* pp. 202 *et seq.*):

[Page 206, to follow ab. *lafitolii*, Thierry-Mieg.] *Hyles* ab. *restricta*, Roths. and Jordan, "Revision of the Sphing.," p. 720, pl. viii., fig. 11, ♂.—A ♂ in the Tring Museum has the forewing entirely tawny-olive above, except a small spot at end of cell. and a series of small elongate hastate or linear spots on the disc upon the veins; fringe of hinder margin buffish-white, that of distal margin clay colour; marginal band deeper brown. Disc of hindwing above yellowish-red, far less bright than in ordinary *euphorbiae*. Underside of body and wings much shaded and speckled with brown, especially the wings; forewing with very little red, hindwing yellow-red on disc. Caught on the drill ground at Bamberg. Received from A. Heyne (Rothschild and Jordan).

[Page 207.] *Hyles* var. *paralias*, Nick.—Transfer reference to Staud., "Hor. Soc. Ent. Ross.," xiv., p. 297 from *paralias*, Nick., to *conspicua*, Rothschild and Jordan, "Revision of Sphingidæ," p. 720.

[Page 208.] *Hyles* var. (an ab.) *esulae*, Bdv.—The name of this form is changed to *nigrescens*, by Rothschild and Jordan (*Revision of the Sphingidae*, p. 720).

4. [Page 210.] *Hyles* var. (an spec.) *lathyrus*, Walk.—Rothschild and Jordan (*Revision of Sphingidae*, pp. 720 and 727) separate the synonymy that we quote, into two sections, *viz.* (1) that relating to the Syrian, and (2) that relating to the Indian, form. The *lathyrus* of Staudinger's *Catalog*, 3rd ed., p. 103, so far as it relates to the Syrian form (=*paralias*, "Hor. Soc. Ent. Ross.," xiv., p. 297), is renamed *conspicua* by these authors, and is treated as a form of *euphorbiae*, whilst the Indian form [the *lathyrus* of Walker, Butler, and ourselves (*anteà*, p. 210) and the *euphorbiae* of Hampson] is treated as a variety of *Hyles nicaea*. Rothschild and Jordan's imaginal material, on which this separation is based, appears to be somewhat slight (3 ♂s of *conspicua* and 2 ♂s of *lathyrus*), but these authors are very decided in the opinion as to the accuracy of their conclusion. Even if the separation be accurate we should treat *conspicua* as a species separate from *euphorbiae*, as, indeed, we consider almost all Rothschild and Jordan's so-called subspecies of *euphorbiae*, Linn., to be. Their description of *conspicua* is as follows:

Conspicua, Roths. and Jord., "Revision of Sphingidæ," p. 720 (1903). *Euphorbiae*, Mann, "Wien. Ent. Mon.," vi., p. 66 (1862); Bartel, "Pal. Gross-Schmett.," ii., p. 79 (in part) (1899). *Euphorbiae* ab. *paralias*, Staud. (*non* Nickerl), "Hor. Soc. Ent. Ross.," xiv., p. 297 (1878); Hofm., "Gross-Schmett.," p. 30 (1894); Holtz, "Illus. Zeits. für Ent.," ii., p. 63 (1897). *Euphorbiae* var. *lathyrus*,

Staud. and Reb. (*non* Walker), "Cat.," ed. 3, p. 103, uo. 749*f* (in part) (1901).—♂ ♀. A large and pale form resembling small specimens of *nicaea*. Mesothoracic tegula with vestige of white upper border, costal margin of forewing with little brown scaling, patch beyond end of cell isolated, very sharply marked, distal marginal area as pale as disc. Underside of body as pale as in *centralasiae*. Spines of first protarsal segment stout. Larva varying from yellow to black; two rows of large lateral spots; very few or no dots, differing in this respect very conspicuously from typical *euphorbiae*. Hab. Syria and Asia Minor. 3 ♂ and 7 larvæ in Tring Mus., from Beirut (type), and Haifa (Rothschild and Jordan).

5. [Page 211.] Besides *Hyles robertsi*, Butl., Rothschild and Jordan treat Püngeler's *siehei* and Nordmann's *costata* as subspecies of *H. euphorbiae*. They also describe another Indian insect as subsp. *nervosa*. Their descriptions of these are as follows:

Hyles euphorbiæ subsp. siehei, Püngeler, "Berl. Ent. Zeits.," xlvii., p. 235, pl. iii (♂ and ♀) (1903); Roths. and Jord., "Revision of the Sphingidæ," p. 720 (1903).—♂ ♀. Mesothoracic tegula with pale upper border. Costal median patch of forewing much reduced on upperside, uot distinct below. External spines of first protarsal segment few in number aud large, agreeing best with those of the followiug form (*centralasiae*, Bienert). Habitat: Bulghar Dagh, Cilicia. June. 1 ♂, 1 ♀, Tring Museum (Rothschild and Jordan).

Hyles euphorbiæ subsp. nervosa, Roths. aud Jordan, "Revision of Sphingidæ," p. 721 (1903).—♂. Mesothoracic tegula with white upper edge. Abdomen: two black lateral spots; friuge of tergites not white in middle. Forewings: upperside with costal area clay-colour from base to near apex, broadly shaded with black behind from base to M_2, then sinuate; in this series an indistinct black patch; the patch beyond apex of cell merged together with costal area, less rounded than in *t. thymali*, more so than in *costata*, edged with black behind; veins traversing discal band pale like median area as in *costata*; marginal band pale. Underside of wings speckled with brown; cell of forewing brown, the area ending in a blackish patch; disc of forewiug slightly pink, that of hindwing pale pink. Hab.: Sabathu, N.-W. India. Two ♂s in British Museum. Resembling *costata*; third abdominal segment without indication of a black patch; underside of wings more pink (Rothschild and Jordan).

Hyles euphorbiæ subsp. costata, Nordm., "Bull. Mosc.," xxiv., 2, p. 444, pl. xi., figs. 3-4 (1851); Staud., "Cat.," 2nd ed., p. 37 (1871); 3rd ed., p. 103 (1901); Butl., "Trans. Zool. Soc. Lond.," ix., p. 569 (1877); Graes., "Berl. Ent. Zeits.," xxxv., p. 211 (1892); Kirby, "Cat. Lep. Het.," i., p. 665 (1892); Bart., "Pal. Gross-Schmett.," ii., p. 95 (1899); Roths. & Jord., "Revis. of Sphing.," p. 722, pl. ix., fig. 10 ♀ (1903)-♂ ♀. We do not believe this insect is specifically distinct. We have seen only a few. Nordmann's figure is not very exact. Mesothoracic tegula with white upper border. Body above and forewing deep cinnamon-brown; abdomen with a small brownish-black side-patch on 4th segment as in *dahlii*. Costal area of forewing broadly brown sharply marked, patch beyond apex of cell merged together with it, narrower than in most forms of *euphorbiae*; veins traversing brown discal band pale as in *nervosa* and certain *mauretanica*; inner edge of brown band more straight behind than in the other forms of *euphorbiae*. Hindwiug below with the black submarginal band (so sharply marked in Nordmann's figure) vestigial; body and wings with little red on the undersurface. Early stages not known. Hab: Transbaikalia, Kiachta, Raddefka In the Paris Museum, 1 ♀ from Kiachta (Popoff) (Rothschild & Jordan, "Revision of the Sphingidæ," pl. ix., fig. 10., p. 722).

Daphnis nerii, Linné (Vol. iv., p. 249).

[Page 250.] Variation.—There is very little tendency in *D nerii* towards variation. The colour of the divided pink band may vary from the normal pale to very dark pink. The dark pink is rare. I have two large females of this form. One of them has the second interrupted band, which is usually white, strongly tinged with pink. Another aberration, of which I possess only one specimen, has the pink band almost entirely suffused with green. The depth and extent of the green vary slightly.

The neck collar is usually light grey sometimes tinged with pink. More rarely it is dark grey. I have noticed this phase of development most in very late specimens (Powell).

[Page 251.] Egglaying.—Always laid singly, on upperside of leaf, low down on plants. In spite of the comparative abundance of young larvæ in September, 1903, at Hyères, close search for ova only resulted in the finding of one empty eggshell which was on the upperside of a small leaf on the growing point of a branch low down on the plant; the very young larvæ are nearly always found in a similar situation (Powell).

[Page 251.] Ovum.—Rather pale green, smooth and shiny; almost round in outline, but with a flattened base. The empty shell is practically colourless, thin, and nearly transparent (Powell).

[Page 251.] Habits of larva.—The very young larvæ are nearly always to be found on the small leaves of the lower branches of a plant, whilst, in their last stage, the larvæ are generally found at the top of a shrub feeding without a pause at the extremities of the juicy shoots, and frequently even eating the flowers. I am sorry I have no exact data as to the duration of each larval stage, but growth is rapid, the larval state lasting about three weeks or a month in the warm weather of late summer and early autumn (temperature on an average=max. 25° C., min. 12° C.), but the individuals found late in October are retarded by colder weather and do not attain a large size. As just noted, the young larvæ are to be found mainly on the undersides of the leaves, always near the top of a tender shoot, and low down on the shrub or tree. They move from one branch to another occasionally, without having finished all the tender leaves on the last. As soon as the 5th instar is reached the larvæ make for the top branches of the shrub and eat the freshest leaves obtainable. The larva feeds continually in this stage, night and day, only ceasing in order to reach another branch when all the tender leaves (and some of the tougher ones) on the branch it has just left, have been entirely or partly eaten. It is easy to detect the presence of a fullfed larva on a tree by the appearance of the tops of the main branches. If a larva happens to meet with a flower or flower-bud it will not eat leaves again if flowers are available, and, as the trees are in blossom at the time the larvæ are feeding, this often occurs. This makes them rather more difficult to find, for it is not easy to discover their traces amongst the masses of flowers, however, by searching on the ground beneath the oleander bushes, large droppings are seen at once should a larva be present. The oleanders cultivated here, at Hyères, have white, pink, dark pink or salmon-coloured flowers, and larvæ are to be found on all of them, but rather more commonly on the white-flowered trees. The leaves of the white oleander are generally more tender than those of the other kinds, which may account for the preference. Wild oleanders, with pink flowers, grow in some of the dry watercourses to the east of Hyères, and the leaves of these wild shrubs are tougher than those of the cultivated specimens. One autumn, when larvæ of *D. nerii* were plentiful in the gardens and oleander hedges near Hyères, I examined numbers of these wild trees, but found no trace of larvæ of this species on them. When at rest, the larva raises its head and forelegs, contracting its thoracic segments, so that the great blue and

white eye-spots are folded in and almost invisible. When touched or startled it arches the forepart of the body, brings its head down underneath as far as the first pair of claspers, thus tightly stretching the thoracic segments. The eye-spots are then fully displayed, giving the larva a remarkable appearance, and there can be no doubt that these spots are a means of protection to the larva. It cannot defend itself, but one can imagine a bird or reptile being startled by a sudden movement of the larva displaying two such brilliant false eyes. It is unlikely, however, in this country, that any birds or reptiles prey on it. The earliest dates on which I have found larvæ were in July, 1900, a year in which they were later on extremely abundant; between the 12th and 15th of July of that year I found six fullfed and exceptionally fine specimens, which pupated about the 20th, and the moths emerged between August 3rd and 9th. A friend of mine also found some at this time. Since then I have often examined the oleanders in July but have never found larvæ. the usual time for their occurrence here being in September and October. They are to be found in August but do not become plentiful as a rule until towards the middle of September. In 1899 and 1900, I found some during the 3rd week of August and great numbers in September; 1901 and 1902, were very bad years, the larvæ being scarce (2 fullfed September 16th, 1902, none seen in August). This year (1903) they have been fairly plentiful but late There were hardly any to be found in early September, as I hear from a friend who was collecting in Hyères, and even when I arrived on September 22nd there were not many. However, by the end of the month they had become plentiful, especially in the younger stages, and were abundant during the first fortnight in October. I did not look for any after October 25th, but, on that date, individuals at the beginning of the last stage were still to be found. Last year (1902) I found three nearly fullfed larvæ on November 9th, and have even, occasionally, found larvæ in the 3rd stage in November. It is usual for the larvæ of *D. nerii* to occur singly; occasionally, however, two larvæ of the same age and probably from ova laid by the same female, are found on one tree. When the species is abundant, as many as 4 or 6 larvæ may be seen on the same tree, but then they are never all exactly of the same age; this usually happens in the case of an isolated and attractive tree. I have never found larvæ upon *Vinca*, another reputed foodplant (Powell). In confinement a larva in its last stadium was placed upon a young potted oleander plant, when it at once made for the topmost leaves; it held tenaciously to its foodplant, possessed a voracious appetite, and evidently preferred the young to the fullgrown leaves; it fed freely and systematically, finishing each leaf in a workmanlike manner, with the exception of the larger leaves, which it either did not like so well or could not complete without leaving hold of the stem, which the larva evidently did not care to do. When eating the smaller leaves it would extend itself to the full, drag back the leaf until it was bent nearly double to be held by the legs, when it commenced feeding on one side at the tip, eating right across the leaf, including the midrib. The leaf was bent backwards with the upper- or underside uppermost, as was convenient. The larger leaves were attacked at about the centre of one side, and the larva fed backwards from thence evenly to the midrib, which it

did not, however, attempt to eat. When the leaf was eaten away to the stem on one side, the other side was treated in the same way, leaving the apical part of the leaf untouched, *i.e.*, all that part beyond the point at which it had commenced feeding. When it had devoured the young leaves at the top of the plant (which it ate to the last morsel, and in some cases the shoot also), it tried the larger and more mature leaves, and, after serving some of them in the manner described, it descended the main stem and ascended the lateral shoots, which it stripped of the young leaves as it had done at the top of the plant. When moving from point to point on the plant in search of fresh food, it had a peculiar motion, swaying gently the head and front segments (from the 2nd abdominal), accompanying this action with a movement of slow recoil and extension; had this movement been a quick instead of a very measured one, it might have been described as a darting action. Whether the larva, when thus occupied, was searching by sight or scent for its next point of attack upon the foodplant, can only be conjectured. It did not leave the plant until it was fullfed and ready for pupation. Whilst feeding it would sometimes assume a striking posture in which, sustaining itself by the last three pairs of prolegs only, it would stretch out and bend over its thoracic segments until the head rested on the 1st pair of abdominal prolegs; this attitude brought into strong relief the two ocellated blue spots which, stretched to their full extent on the dilated segment, resembled two staring eyes, while the pendent segments and head below looked like a long proboscis. More generally the attitude of repose was that of quiet extension, with the thoracic segments contracted; on these occasions all that was visible of the ocellated spots was a slight suggestion of the posterior edging of their black circumscription, as the rest of their form was covered by the heavy enwrapping skinfold of the mesothoracic segment (Dollman). After ceasing to feed the larva rests for an hour or so, and then commences to pass its mouth over the body, secreting a rather sticky-looking fluid as it does so. It applies the fluid to all parts of its body, working slowly and carefully. The thoracic segments do not escape this treatment, and, to reach them with its mouth, the larva has naturally to go through some difficult contortions. The fluid dries rapidly on the skin, and, as far as I can see, the only object of this proceeding is to toughen the skin; certainly the skin is much tougher in the morning, and by this time the change of colour is complete. It takes the larva many hours to thoroughly cover every part of its body with the secretion. An hour or so after sunrise, when the heat is beginning to make itself felt, the fullfed, and now darkened, larva becomes restless. If it be now taken from the tree and placed on some loose mould mixed with rubbish or dead leaves it will at once burrow into the heap, and commence to spin a cocoon, but if left to itself on the tree it becomes more and more restless as the power of the sun increases. It makes its way down, or falls to the ground, and, being thoroughly warmed, it starts off at a rapid pace, covering a considerable distance before it decides to spin up. I have often found them on the road at this period. The late larvæ, influenced by cold, do not go through the darkening process in the normal time; the

time taken may be increased by half-a-day to two days, according to temperature, and the change is never so thorough as in warm weather. In cold weather (say night temperature of 5 °C. to 8 °C. with cold dull days, or with a mistral) the orange colour becomes greenish and pale, and the dark dorsum smoky greyish-black, not intensely black (Powell).

[Page 254.] ONTOGENY OF LARVA.—*First instar:* The larva is slender, pale green or yellowish-green in colour; the caudal horn black, very long and thin. [The larva in this and the next two stages, when not feeding, lies along the midrib at the back of a leaf, the caudal horn in the 1st and 2nd stages being laid flat along the midrib behind the larva when the latter is at rest, but held in an almost upright position when the larva is moving.] There is a faint indication of the blue ocellated spot on each side of the metathorax even in the first stage. *Second instar:* The white-centred, blue metathoracic ocellated spots are rather more distinct, and the yellowish-white subdorsal line which runs down the abdominal segments to the base of the caudal horn, well above the spiracles on each side of the body, is visible. The horn is also shorter in proportion to the length of the larva. *Third instar:* Just after the second moult the length is 32mm. not including the horn. Caudal horn 7·5mm. Head green, smooth. Thoracic segments telescopic and tapering towards the head. Body green, rather milky-green on dorsal surface. The metathorax has on each side a small blue, white-pupilled spot, behind which commences, very faintly, the creamy subdorsal line which runs down to the base of the horn where it nearly joins the corresponding line from the other side of the body; it is very weak on the metathorax, weak on the 1st and 2nd abdominal segments, strongest on the central segments and continues well-marked on the 6th, 7th and 8th abdominals. It contains three small slightly raised white spots (and two others are just below it) on the 1st abdominal segment; several others on the 2nd abdominal segment on its upper edge and below. On the 1st subdivision of this segment a line of these spots runs up towards the dorsal centre, sometimes nearly meeting those from the other side of the larva, and further back there are a few more white spots on the dorsal surface above the creamy line. A somewhat similar arrangement exists on all the remaining abdominal segments, but after the 3rd the number of white spots diminishes, and on the 8th they are reduced to two or three or are absent altogether. The creamy line has a dark green shading below it especially towards the end of the body. The spiracles are vertical black slits bordered narrowly with whitish. The true legs pink outside and at the extremities, greenish inside. The prolegs are pale brown but the fleshy parts of them are green. The caudal horn pale yellowish, waxy looking; fairly straight, inclined backwards, contracting abruptly about the centre, and ending in a thin bayonet; the surface granular, the bayonet so also but more finely. The larva is slightly transparent, the contractions and expansions of the dorsal vessel being clearly visible beneath the dorsal surface on the 6th, 7th and 8th abdominal segments. *Fourth instar:* Much like the last, the markings being of course

Pl. I.

Daphnis nerii—Larva and Pupa.

larger and rather clearer. The bayonet on tail reduced. *Last instar:* The appearance of the larva in this stage is fairly well-known. The ocellated spots forming circular blue patches with white centres on metathorax are now very large. The subdorsal lines are white and striking. The white raised spots, arranged as in third instar, are enamel-like in their brilliance; they vary considerably in number and minor arrangement in different individuals; many of them are partly absorbed by the white line, and in some larvæ the line is chiefly composed of these spots which have "run" or joined together. The caudal horn no longer has a bayonet. It is a short orange-coloured appendage curved over backwards, with a rough surface. When fullfed the larva is an unwieldy-looking object, with a very small head compared with the size of the body. There is often a pale lilac tinge just below the white line (Powell).

[PAGE 254.] LARVA.—*Final instar:* The larva described (pl. i) is not of the usual green and yellow form, but of a scarce variety, mainly fawn and soft liver-coloured in appearance. Extended, it is rather more than 4 ins. in length, lithe, slender of form, and of great grace and daintiness in construction. The head is small and oval, partly retractile within the prothoracic segment which is just large enough to receive it. The segments gradually increase in size to that of the 1st abdominal, and, though partaking of the Eumorphid character of an increase in girth at this point, the segment is not so dilated as in the British Eumorphid larvæ; from this segment to the 8th abdominal, the larva is full and fleshy in form, and the elevation bearing the caudal horn is steep and emphatic. The transverse subsegmental skinfolds are firmly fashioned but do not destroy the breadth and simplicity of form of the segments they traverse. The caudal horn is small, and directed backwards and downwards. The claspers are powerful nipple-shaped limbs that carry the weighty larva with ease. The colour of the larva is simple and delicate, though of extreme beauty, being a combination of quaker-like fawn and grey liver-colour. The head, which has a porcelain-like surface, is of a soft dove-coloured grey, whilst the main colours of the body are buff and fulvous with the rather darker portions coloured by the soft liver-grey. A thin, well-defined mediodorsal line of liver-colour can be traced from the crown of the head to the posterior edge of the metathoracic segment, where it terminates. At the lateral line is the boundary of the grey liver-colour which covers the lateral and ventral surfaces; the outline of this boundary is carried obliquely upwards and forwards to the anterior edge of each segment after the 1st abdominal, almost to the dorsal centre, thus leaving a series of broad dorsal triangles, or rather pointed dome-shaped spaces, of the fawn-colour. Along the centre of these the intestinal canal suggests a faintly darker mediodorsal line, particularly so at the segmental junctions. The liver-colour of the lateral surface encroaches most freely upon the dorsal fawn-colour at abdominal segments 4 and 5, consequently making the dome-like triangles smaller there than at either end; on the spiracular region is a series of blurred blotches of the fawn-colour, fulvous at the base, in some cases resembling in shape an inverted letter Z. There is one of these blotches on each segment,

but, on the thoracic segments, they are fused, leaving a blurred top edging of liver-colour, which here suggests a short lateral line, as the dorsal surface of the thoracic segments is fawn-coloured; these Z-shaped blotches of fawn-colour bear the spiracles which are tall, narrow, upright ovals, jet-black in colour, with a very fine light lavender ring around them, and, outside this a warm buff-coloured edging which is suffused into the ground-colour, the spiracles themselves being slightly recessed from the body-surface. Commencing at the posterior half of the metathoracic segment, and from a large ocellated spot thereon, is a bright fawn-coloured line very suffused at the edges; at the 2nd abdominal segment this lateral line becomes wider, is of a suffused white tint, in which condition it is continued to the centre of the 7th abdominal, where it abruptly ceases, to be, however, almost at once continued of a bright fawn-colour, upwards and backwards to the base of the caudal horn, where it terminates in a fine point. The whitish part of this lateral line is very suffused on its lower edge, and is strongly emphasised by a series of small pure white spots, set in vertical rows, in a broken manner, upon the segmental skinfolds; these spots are often encircled with a fine buff ring, and stand in colour relief against the ground tint as vividly as small white porcelain beads might do; they are arranged on each segment, in vertical lines, on the liver-coloured portions which enclose the dorsal triangles of the fawn-tint; thus, the first line of dots on the 2nd abdominal segment consists of five dots, one above the other, and nearly meeting the dots from the reverse side at the dorsal centre; the next line of dots on the same segment is shorter and also the following ones, but irregularly, until they merge into the whitish lateral line. It will be understood from this that the ends of these lines of dots on each segment follow the shape of the dome-like marking on the dorsal area; this they do, but do not cross the boundary of the liver-colour. These dots are found vertically placed on the lateral line, on each segment, from the 2nd to the 7th abdominal segments, but gradually diminish in the altitude they reach on each succeeding segment posteriorly, *e.g.*, the first row on the 2nd abdominal segment consists of five dots, on the next segment there are but four in the first row, in the next but three, the next two, and the remaining two segments that possess dots have but one each in their first row, and only suggestions of others on the subsegments following. The legs and the powerful claspers are of the liver-colour of the lower portions of the larva, the claspers having fulvous edges on the pedal formations; the legs are not shiny but have a dull gloss on their surface. The ventral surface is shiny and of the soft liver-colour of the lateral coloration; there is also a slight indication of a very fine suffused lighter-coloured medioventral line. The caudal horn is small, and hangs much like that of the larva of *Manduca atropos;* it is of a bright orange-sienna colour, and very shiny; its surface is roughened by projecting excrescences, and irregularly marked with a few dark dots around its base, its apex is not pointed but finishes bluntly. At the commencement of the lateral line, on each side of the metathoracic segment, is a most gorgeous single ocellated spot of electric bluish sheen that contrast could offer the simple quaker-like

tints of the rest of the larva, and suggesting in colour the phosphorescent gleam of the glowworm's light (October 10th, 1903). *Quiescent period preceding pupation:* The larva (when it has finished feeding) changes greatly in appearance. The whole of the fawn-colour turns to deep fulvous; the dorsal area, from the 2nd abdominal segment extending to the caudal horn, and reaching down laterally just below the subdorsal line, becomes of a dark umber-brown colour; the dome-like triangles disappear entirely; the lines of the head assume the same dark umber tint, as also the fine mediodorsal line on the prothoracic dorsal surface; a half-circular plate-like marking of the same colour appears on the dorsal surface of the prothoracic segment, the straight side thereof on the anterior edge, where there is a narrow fulvous edging between it and the head. As noted, the light fawn portions turn to a deep fulvous, but the anal end and claspers are the strongest of these parts in colour being of a quite deep sienna tint. The metathoracic ocellated marks have now lost their beauty, being suffused with black from the jet black of the bordering rings, and the only indication of the gleaming blue centres is a small core of dull purplish colour. Those portions of the larva which had been of grey liver-colour are now of a dull coffee tint. The suffused white lateral line has almost vanished, but the transverse rows of small white spots show in strong relief on the dark ground. The caudal horn is of the same colour as before but looks more brilliant by contrast with the dark dorsal development. Taken as a whole the larva now appears more like the typical form in these changed colours than it did in those which preceded them (October 13th, 1903) [Dollman].

[Page 257.] VARIATION OF LARVA.—From the middle of September to October 25th, 1903, the larvæ were common at Hyères, some 140 having been taken. The beautiful light brown form (described by Mr. Dollman *suprà*) was rather more abundant than usual, for it formed about 8·33 per cent. of the whole, the usual percentage not being above 5. The individuals of the brown form vary somewhat in the intensity of colour and extent of darker brown markings, and some examples develop these characteristics very early, the darker hue having been observed in the second instar; the colour is then of a pale "tea-and-milk" tint with no deeper brown markings apparent; at other times, however, the special colour does not appear until the 3rd or 4th instar, when lighter and less strongly marked individuals than the form described above are found. In these, the "strong tea and milk" coloration is paler and yellower, the brownish markings weaker and less clearly traced. When, however, the colour is developed early there results a very strongly-marked final stage, like that described by Mr. Dollman (Powell).

[Page 257.] COCOON.—The puparium is quickly made. It is composed of almost any kind of *débris*, earth or dried leaves, spun up with coarse brown threads. It is neither compact nor very rigid, but the threads are fairly strong. There is plenty of room for the pupa inside. All stones and lumps are, however, removed from the earth on which the pupa lies, leaving a smooth bed. The pupa is formed from 5 to 7 days or more after the completion of

the cocoon, the time depending very much upon temperature. The shortest time is taken in hot summer weather (Powell).

[Page 257.] PUPA.—*Newly-formed* (October 20th, 1903): Very delicate and fresh in appearance; the front part (head and thorax) of a bright light greenish-grey, the posterior portion of a bright butter-coloured yellow tint; the whole of the surface translucent and shiny. [The pupa extremely lively and active, taking alarm at the least occasion.] The whole of the dark markings to be described quite as pronounced as afterwards, but warmer and more red in colour. In outline, the pupa is slenderly formed, graceful in outline, exactly $2\frac{3}{8}$ins. in length. The form of the head, antennæ, legs and wings traceable under their respective sheathings. The wing-cases long, the point of the segment at which they terminate sharply incised, the segments from the head to the point being full and firm in character; the body posterior to the termination of the wing-cases less in circumference, and tapering but gradually to the anal segment where it rounds off suddenly to the anal point (October 20th). *Five days later:* By October 25th the pupa had deepened in colour to a rich light sienna tint freely freckled, though minutely, with a deeper shade of this colour. The head and thorax large and bold in form, and, after a slight depression in the outline at the 1st and 2nd abdominal segments, the pupa swells gradually to the posterior edge of the 4th abdominal, where it is emphatically scored all round by the segmental division and marked with a deep sienna band; the two following segmental incisions are also similarly accentuated. These three segments are much more heavily depressed as well as covered at their posterior divisions than the remainder, though all are distinctly and sharply defined. The anal end is the richest in colour of any part of the pupa, gradually becoming deeper in the sienna tint as it reaches the anal point, which is about $\frac{1}{16}$in. long, projecting backwards and slightly upwards, finishing in two minute points diverging laterally, and is also of a deep brown colour, and neither smooth nor shiny in surface. On the head, in the extreme front between the eyes, is a short, broad, intensely dark line, suffused at the edges, which commences immediately on the forehead between the eyes, and travels upwards to stop when vertically over their centre, and is set in an edging of unfreckled sienna-colour; this dark line commences again behind the head on the junction of the thorax with the head; it here dilates into two rather diamond-shaped swellings, then traverses the thorax as a mediodorsal line to stop again abruptly, on the posterior end of the thorax, where it again expands into a diamond-shaped blotch. [These markings, in dark brown line, are most vividly and decidedly drawn upon the pupa and are thick and firm in character.] From this point the mediodorsal line extends, in a broken interrupted manner, to the anal segment, but is only faintly indicated upon the centre of the segments; on the anal segment is a small but very distinct dorsal spot. There is a subdorsal series of small darkish ticks (or marks) on the anterior edge of each segment beginning at the 1st abdominal; these are gradually more removed from the dorsal centre as the segments widen, and, as they decrease in size, again approach it more nearly. There are also two pairs of small dark sub-

dorsal dots on the thorax—one pair composed of a dot on each side of the mediodorsal line, the other pair of a dot on each side at about the junction of the meso- and metathoracic segments; below the last pair is a small elongated mark. The bases of the antennæ are also diffused with a thin dark transverse line. The prothoracic spiracular mark is seen in a dorsal view, as is also a suggestion of that upon the 2nd abdominal; these are placed in large, intensely dark-brown conspicuous blotches. The lateral view of the pupa is distinguished by two main characteristics, the long wingcases and the series of large and very dark blotches which mark the position of the spiracles; the first of these is on the prothoracic segment, just above and behind the eye, which possesses a fine semicircular dark mark resting on the sheath of the antenna; on the 1st abdominal segment the dark blotch is not visible, or only very faintly suggested, so faintly that it can hardly be recorded with certainty, for here the wing-cases enwrap it rather deeply; on the 2nd abdominal the spiracular blotch is uninterruptedly in view; on the 3rd the lower half of the blotch is concealed by the angle of the wing; that on the 4th abdominal is the largest of the series, is roundish in outline, though jagged and suffused at the edges; the remainder all rather smaller or more elongated in form, inclining to a posterior, tail-like point in the marking. On the 8th abdominal, just below the spiracular blotch, is a small, dark marking, consisting of two finely drawn vertical ticks (or marks), side by side, and, on the anal segment, is a small round dark dot on the spiracular line. The wingcases are extremely thin and transparent, and, while showing the neuration distinctly, also exhibit the segmental divisions with their local colour through their transparent texture. The ventral view is remarkable for a most distinctive feature, *viz.*, a broad, strongly drawn, intensely dark, medioventral line extending from the base of the proboscis on the head (but separated from the short dark mark on the forehead) to the apices of the wings on the 4th abdominal segment; the line is as firmly and sharply drawn as if it had been made with a J pen along a ruler. In the centre of this dark line is an extremely fine light thread-like longitudinal line. The packing of the proboscis, legs, antennæ and wings is wonderfully neat, and the form of these organs can be fairly well discerned by their coverings. On the abdominal segments which bore the prolegs (in the larva), there is a large brownish-red blotch where each proleg had existed, except upon the anal segment where no such marks are visible. There are three small dots on the anterior edge of the 7th abdominal segment, a central one, and one aligned with it on either side. The subspiracular marks of the two ventral ticks (or marks) on abdominal segment 8 are also visible in the ventral view of the pupa. A faint suggestion of a medioventral line runs from the termination of the thick dark line on the posterior edge of the 4th abdominal segment, to the anal point, broken only, just short of that, by the anal aperture and genital organs. A careful examination was made of the venter to determine, if possible, the exact position of the embryonic legs, antennæ and wings, and their general form could readily be made out by slowly moving the pupa so that the light was reflected upon the various prominences, but it was not easy to come to a decision

concerning various details as the pupacase did not define with much exactness the limits of the limbs. The serrated sheath of the antenna starts squarely from above the eye-covering and descends downwards and backwards to be inserted just past the junction of abdominal segments 1 and 2, between the 2nd leg and the costal line of the wing-case. The 1st leg shows its upper visible segment (the femur) close behind and below the glazed eye and between here and the maxillæ, on the upper edge of the prothoracic segment; from this point the next segment (the tibia) descends obliquely backwards, its lowest point being situated near the thick dark medioventral line before alluded to, at the junction of the meso- and metathoracic segments, whilst the last segment of the leg (the tarsus) terminates upon the 2nd abdominal segment, lying close against the broad dark medioventral line The femur of leg 2 commences at about the centre of the mesothoracic segment, against the tibia of leg 1. The junction of this segment of leg 2, with the tibia, is not definitely visible through the pupa-case, but the tibia terminates on the anterior edge of abdominal segment 1. From thence the tarsus extends, packed closely against the broad medioventral line to the centre of abdominal segment 3, where it terminates. The detail of the 3rd leg could not be made out as it is packed beneath and behind the costa of the wing, but, as the imago advances towards emergence, the lower joint can be faintly discerned through the wings on the posterior portion of abdominal segment 2, from whence its last segment doubtless lay beneath the wing costa, but its termination could only be guessed at. The wing extends to the extreme posterior edge of abdominal segment 4, where it is carried slightly round the full edge of the segment almost to the deep depressed division from the next segment; hence it ascends upwards and forwards in a graceful curve to an angle on the lateral centre of abdominal segment 3, the point of the angle impinging on and crossing the lower portion of the spiracular blotch there; it is then carried forward in a hollow curve to the shoulder in the thoracic region. The nervures are well-defined, firmly, though delicately, traced upon the surface, the marginal edging to the wings sharply and neatly incised. The lines upon the head and thorax marking the structural divisions thereof are defined in thin brown line, slightly, but sharply, depressed at their edges. [The pupa becomes much quieter after its first week of existence and seldom moves or shows signs of life when undergoing inspection.] It very gradually deepens in colour to a distinct sienna tint, especially on the dorsal surface, and, by October 30th, seemed to have reached its final stage in this direction. The ventral surface and wings remain fairly light and clear, the latter preserving very little of the freckled appearance which was noticeable on the other portions of its surface, and which had now turned dark, almost to blackness, on the anterior part of the dorsal area of the segments. *Mature pupa* (November 5th, 1903): The pupa has now lost its transparent and shiny look; the whole of the surface opaque and although warmer and more ochre-coloured than putty-coloured, it suggests the dull dead surface of putty. The ventral portion of the thorax, containing the legs, is lighter and rather greyer in tint than the rest of the pupal skin, but shows no tendency towards the colour-markings of the imago. The darkening of

the pupa from this time onwards is very gradual, the first portions to change colour being the head and eyes, which slowly deepen to a blackish-brown, and by the 15th of the month the antennæ and legs had asserted themselves darkly through the skin. The entire pupa has now become strongly marked with minute dark freckling; on the dorsal region these freckles have taken the form of transverse lines, doubtless on the basis of the larval skinfolds; the ventral area and wings also develop a quantity of dark freckling, but it was not until November 20th that the pattern of the wings began to be visible through the pupal skin; these quickly intensified, and, on the 23rd, were fully pronounced, and the wings were almost covered with the markings in a dark olive-black. The dorsal region had also darkened to a like degree of the same colour, and the transverse series of freckled lines was almost lost in the general deepening of the olive-black tint. On the 25th of the month the pattern of the wings through the pupal skin was most distinctly defined and the ocellated spot on the metathoracic segment sharply visible, *i.e.*, the marking formed on the shoulder of the imaginal forewing. The whole pupa was now very dark, the pupal skin semitransparent with the appearance of tracing-paper. The pupa was still very quiet. The imago emerged on November 26th, the pupal condition having lasted 37 days, the pupa being kept at an average temperature (day and night) of 70° F. (Dollman). Powell says that the *newly-formed pupa* is at first almost white, although the black spiracular patches, the ventral black line, and dark dorsal markings are already present, that it darkens steadily for a few days, and is finally pale yellowish-brown on wing-cases, leg- and antenna-cases, rather darker on ventral area of abdominal segments and darker still on the back. The wing-, leg- and antenna-cases have a smooth surface. A shiny black line with an incision down the centre runs from between the eyes, separating the wing-cases and ending just beyond the tips of the wings. A rather thick black line runs down the back of the thorax, and there is a short one on the head, continuing the shiny ventral line after a slight break. The spiracles enclosed in rather large irregularly rounded black patches. The following are a few measurements taken of various-sized pupæ—3 ♂, and 3 ♀:

	Width at shoulders of wing-case.	Width at 3rd abdominal segment.	Total length from top of head to extremity of cremastral spike
1st pupa ♂ ..	17·5mm.	17·5mm.	66·6mm.
2nd ,, ♂	16·5 ,,	17·0 ,,	69·0 ,,
3rd ,, ♂	16·8 ,,	17·0 ,,	72·7 ,,
4th ,, ♀	15·4 ,,	16·2 ,,	68·0 ,,
5th ,, ♀	17·0 ,,	17·5 ,,	72·0 ,,
6th ,, ♀	16·5 ,,	17·8 ,,	75·0 ,,

[Page 258] Pupal development.—The length of the pupal state varies very much, and naturally depends upon the temperature. My pupæ of July, 1900, produced moths in a little over 15 days. Those formed in the beginning or middle of September usually hatch in three weeks, whilst this year (1903) early October pupæ

hatched a month later. Still later pupæ (October 15th-20th) did not produce moths until the 2nd and 3rd weeks in December, and I think it very unlikely that they would have produced imagines at all if left out-of-doors. We had some cold weather in late November and early December, during which time I kept my pupæ indoors. The markings of the wings had been showing for three weeks at least before the moths emerged. Two of these late moths were deformed, and the others, though well developed, had the colours pale, the green being yellowish-olive, even rusty-olive, in some specimens. I have still (December 22nd) 22 living pupæ, many with the moths almost completely developed, others showing no sign yet beyond an increased opacity of the wing-cases, and a darkening of leg- and eye-cases. Pupæ formed late in November partly develop the moths in the course of the winter, but they do not hatch. I had six such last year, which I kept outside. They all died towards the end of January, and, on opening them, I found the moths nearly complete, but their wings were uniform brown. I am convinced that no pupæ pass the winter alive in the open in the south of France, and feel pretty sure that, in average years, no moths emerge later than the middle of November in the wild state. Very late pupæ have light brown streaks on the wing-cases along and between the nervures. Moisture is certainly harmful to the pupæ. If kept too damp they generally rot and turn black. I always keep mine perfectly dry and with very good results. The autumn rains must destroy a great many out-of-doors. The pupa to begin with is very sensitive, and, at the least touch, it will swing the free abdominal segments round violently ; it is, in fact, one of the most muscular pupæ I know. When the wing-cases become decidedly opaque indicating that the moth has commenced to mature, the pupa loses a great deal of its sensitiveness. This returns again, however, when the moth is nearly matured inside the pupa-case. The eyes can be seen shining the night before emergence, and, if examined only a few hours before, they are seen to be brilliant. The markings of the wings are also very evident (Powell).

[Page 259.] Parasites.—I think I may safely say that the larva of *Daphnis nerii* is entirely free from parasites in southern France. I have bred in all about 500 moths and have never lost a single larva or pupa from this cause (Powell).

[Page 259.] Habits of imago.—In summertime, and early autumn, the moths emerge from the pupæ between sunset and midnight, 8 p.m. being an average time. Cold weather upsets all this, and often delays emergence many days after the moth is ready, if it does not prevent it altogether. The moths climb up and rest on the sides of the cages holding the thorax well back during the development of the wings. This process is soon complete, but the wings still hang back and down for about two hours. Then the distance between them widens, and they are brought down rather abruptly into the position of rest usual in hawk moths. The moth then settles itself closer to the cage side, and tucks its antennæ under the wings, close to the body. Next morning at daybreak the moths fly, but their flight is of short duration, for all are at rest again before sunrise. [To prevent this they should be placed overnight in a cupboard or dark room where no light will reach them in the morning. They can then be killed at any time

during the day, and will be in perfect condition.] If left to themselves they will again fly for a short time after sunset. Out-of-doors the moths are very rarely seen, though they must be abundant enough some years in early autumn. I have only once taken *D. nerii* at flowers, though I have on a few occasions found them in the daytime resting on palings or bushes. Dr. Siépi has taken them in September, flying round petunias at Marseilles, but never commonly. I may say that most of the facts I have been able to obtain concerning *D. nerii* lend strength to the theory that it is not a true native of southern France, but a species renewed here entirely each year by immigration. All late pupæ make an attempt to mature the moth during winter, but without success out-of-doors after about November 15th. I have never known one to pass the winter and hatch in the spring, and, therefore, it is pretty certain that *D. nerii* does not hybernate as a pupa. I have found no larvæ nor ova in winter or spring, my earliest date for the larva being July 12th (it is true that those captured were nearly fullfed at this date, but they are rapid growers and had probably left the ova not earlier than the middle of June). As to the possibility that the perfect insect may hybernate, I have not proved that it does not do so, but I have never come across one either in winter or spring, nor do I know of any record of *D. nerii* in spring in southern France. A few specimens, bred in November, which I kept out-of-doors in a large cage containing some foodplant, died in about a fortnight, and, apparently, no pairing took place. No eggs were laid, and two females which I dissected had no trace of eggs in their bodies. I feel compelled, therefore, to consider those specimens, which have been reported as occurring here in June, immigrants. Many more must in some years arrive later in the summer. It is reasonable to suppose, however, that many of the September and October larvæ are the offspring of moths that have emerged here in the summer, and not first descendants of the immigrants. I often wonder where these travellers come from—possibly from southern Italy, Algeria or Greece. It appears that *D. nerii* is abundant in Asia Minor, and is, no doubt, firmly established there, but it is hard to believe that our stock is kept up from such a distance. The moth is a powerful flier, but its flight is of short duration, restricted to half-an-hour or less at dawn and after sunset. One is tempted to ask whether, when migrating, it keeps on the wing all night or comes on by short stages at dawn and dusk. If it crosses the sea it must be on the wing for a fairly long time. The larvæ occasionally found in central Europe, which certainly must come from immigrants, and the moths sometimes met with in England and northern Europe, prove pretty conclusively the migratory habits of this species. It would be interesting to find out whether more specimens have been recorded in the north in those years in which *D. nerii* has been specially abundant here in the south, *e.g.*, 1899, 1900 and 1903 were years of abundance at Hyères, 1901 and 1902 years of scarcity (Powell).

[Page 259.] Time of appearance.—My earliest moths emerged between August 3rd and 9th, 1900, from pupæ formed about July 20th. Here are a few other dates:—1899: earliest September 13th, 18th, 20th, 22nd, latest mid-November. 1900: September 20th to

mid-November. 1902: earliest October 10th. 1903: earliest November 1st, some still hatching (December 23rd), but not under natural conditions, as I only put them out-of-doors in the daytime when the sun is shining. I have noticed in breeding *D. nerii* that the females are somewhat more numerous than the males. Never have I known the excess so marked as this year, when, from a total of 73 pupæ, I obtained 23 males and 50 females (Powell).

MANDUCA ATROPOS, Linné (Vol. iv., p. 398).

[Page 399.] VARIATION.—Burrows has sent for publication in the *Ent. Record*, detailed notes on various forms of this species. He mentions: (1) The type—A ♀ specimen bred at Rainham, 1896, almost without markings except for the discoidal spot (which is quite tiny), and some short whitish streaks from the inner margin (four on the left forewing and two on the right). The specimen is not quite fully scaled towards the tips of the forewings and a small aneurism occurred towards the extremity of the right forewing. (2) A ♀, exhibiting phæism, the whole of the insect being entirely suffused; the forewings (with rather more extensive pale markings than usual) being suffused, the hindwings and abdomen also suffused but without hiding altogether the yellow, the pale markings of the thorax also darkened. Bred by Clark from a Cambridgeshire pupa, October 15th, 1892=ab. *suffusa*, n. ab. (3) A ♀, bred by Brooks, the upperwings much more suffused with yellow and white than usual, the dark coloration being reduced until it forms two narrow transverse bands which continue the bands on the hindwings; the white scales are extraordinarily increased, covering the whole of the forewings, thorax and abdomen, so that, looked at sideways, it appears to be perfectly white. In this particular specimen also the blackened nervures of the hindwings are continued to the base. This is evidently a more detailed description of our type of ab. *variegata (antea* p. 403) made from a specimen exhibited at the South London Entomological Society, November 8th, 1900, and shortly described *(Proc. Sth. Lond. Ent. Soc.*, 1900, p. 104), and illustrated by the middle figure of our pl. ii. It was bred from a pupa that was found at Long Sutton, Lincolnshire. (4) A fine large ♀ quite pale and faded-looking, yet perfectly scaled and in good condition. Clark coll. (5) A ♀ of the ab. *imperfecta* is in the Burrows coll. Brooks, Clark and Burrows have also each a specimen with the line all but obliterated on the left hindwing only, the right in each case being normal. (6) A ♀, the inner band on the left hindwing ending towards abdomen in a large black blotch, extending and enlarging towards the base of wing, and also extending but narrowing across the yellow space through the outer band, and into the fringe. Clark coll. (7) An example, the left forewing being divided from near the centre of costa to within one-third of the base on the inner margin, the basal portion being quite normal, but the outer and larger area yellow. Brooks coll.

[Page 404.] TERATOLOGICAL EXAMPLES.—The following descriptions have recently been submitted to me by Mr. Burrows *(in litt.)*:

5. The left hindwing with two jagged holes (as though it had been eaten on

the setting-board), the right hindwing uninjured except for two spots of hardened (?) blood. The forewings normal and uninjured. Burrows coll.

This example was forced during the winter of 1894, from a pupa obtained at Rainham. An active light-coloured larva was observed within the left wingcase of the pupa just before the emergence of the imago. The moth emerged satisfactorily, and was perfect except as noted above. The larva was unexpectedly (? rightly) determined as that of *Œcophora pseudospretella*, which is supposed to have entered the pupa (from an affected breeding-cage) after the formation of the imago, and just before it was observed, and to have done the damage described (Burrows).

6. The left forewing deeply scooped along the costa from about the centre of the apex, also on the hindmargin from the apex downwards. Clark coll. (Burrows).

Phryxus livornica, Esper (Vol. iv., p. 147).

[Page 155.] Partial ontogeny of larva.—*Third instar:* At the end of the 3rd instar the length is rather over 23mm. Of two larvæ examined, one was of a lighter form than the other. Its head was yellowish-orange, ground-colour of body black, but the yellow lines were broader than in the other specimen, which had a black head. Both had yellow dorsal, subdorsal and lateral lines; the two last-named widened just before the middle of each segment, the enlargements containing an orange patch; the black ground-colour enclosed between the subdorsal and lateral lines was thickly powdered with yellow dots, and these dots, crossing the subdorsal lines between the centre and the posterior end of each segment, invaded the dorsal surface, forming a small patch on each side of the central line, but not reaching it. The ventral surface black. The legs and prolegs shiny black. The 3rd moult was passed on the morning of June 17th. *Fourth instar:* Length directly after moult, 23mm. The markings stronger than in preceding stage; the head now black in both larvæ. The ground-colour black as before; a fold of black skin on the prothoracic segment just at the back of the head. The darker specimen has now almost entirely lost its yellow dorsal line, whilst the lighter one has it much interrupted. The caudal horn slightly reddish towards the base, the remainder black. At the end of this instar I made another and more complete examination of the larva. The length was then 38mm.-39mm. The subdorsal yellow lines start from the black fold of skin on the prothoracic segment, but the lateral lines pass below it nearly to the head. The central yellow line is obliterated towards the head, and, further down, is broken up into small patches, one or two at the beginning of each segment. In the lighter specimen the subdorsal line encloses a well-developed pale orange spot on each segment, a little before the centre. In the other, these spots are much smaller and do not bulge out the line to any great extent. The orange patches in the lateral line are much deeper in colour and larger than those of the subdorsal line; they are situated below the spiracles in the centre of each segment. Three elongated yellow spots further back than the caudal horn continue the subdorsal line on the last segment, and are inclined downwards towards the lateral line which fades out just above the anal pair of claspers. On each side of the dorsum, at the beginning of each segment,

with its base resting on the yellow subdorsal line, is a velvety-black patch darker and clearer than the ground colour, reaching almost up to the central line. Behind these patches occur the overflows of yellow dots from the lateral area. *Fifth instar:* The dark larva moulted for the 4th time on the morning of June 23rd, the light one exactly 48 hours later. Directly after the moult, the head is pale reddish, but it very soon becomes shiny black; however, a triangular section in the centre retains a reddish tinge. Between the base of the triangle and the mouth is a transverse yellow line with a yellow inverted cone at each end of it, but not touching. The cones terminate each in a feeler at the side of the mouth. The darker of the two larvæ has entirely lost all trace of a dorsal line, and both subdorsal and lateral lines are narrowed. Its yellow markings have a decided tinge of orange Subdorsal line even throughout and now quite free from orange spots. The lateral line is broken beneath each spiracle and the gap partly filled by a small reddish suffused patch. The spiracles are situated in the yellow-dotted lateral area, just above the line. They are upright elongated ovals, orange-coloured, and with a narrow black slit. The yellow dots on the dorsum are confined as before to the 5 or 6 narrow posterior subdivisions of the segment, and do not reach the dorsal centre. The velvety-black patches are somewhat reduced. The true legs shiny black, the first pair with a small yellow spot at the base of the fleshy part; the prolegs shiny black, bases dull black. The caudal horn 8mm. in length, pale yellowish-brown for half its length, darkening to blackish-brown at the tip, and sprinkled with short black spines. There is a slight backward bend in it at about one-third the distance up between base and tip. It springs from a small mound of black ground colour on the 8th abdominal segment. The hood-like fold of skin behind the head, on the prothoracic segment, is prominent in these recently moulted larvæ. Ground colour deep black, in great contrast with the yellow; rather lighter on ventral surface between the claspers. The lighter larva differs from the one described above only in the following particulars :—Yellow markings lighter, forming a rich lemon colour; the yellow dots in the enclosed lateral area more numerous. The spiracles pale orange. The subdorsal and lateral lines broader, the former swollen on each segment rather before the centre, every swelling enclosing a small orange patch (except on the thoracic segments) whilst the latter is interrupted by dull red spots, each with a black dot near its lower edge. The dorsal line is not quite obliterated. Its course is marked by an elongated suffused yellow spot towards the end of each abdominal segment except the last; it is faintly indicated on the thoracic segments. Ventral surface smoky-black, whitish down the centre; abdominal segments thickly sprinkled with minute yellow dots. [Both these larvæ died a few days after entering the 5th instar, owing, no doubt, to the fact that the succulent white-flowered *Galium*, on the flowers of which they were found feeding on June 14th, 1903, and on which I continued to feed them, became too relaxing after being kept a few days in water.] The previous year, on June 14th, I found a larva at the beginning of its 5th instar feeding upon vine. It exactly resembled the

lighter larva described above (Powell).

[Page 156.] Cocoon.—Formed on the surface of the ground, and composed of dried leaves and earth (Powell).

[Page 156.] Pupa.—Measured 49mm. from head to point of spike (below average size); slim, graceful, of polished appearance, light yellowish-brown in colour. Head and thorax finely roughened by small wrinkled pits. Proboscis-case lightly wrinkled transversely. Body minutely pitted. The wing-cases are situated transversely with thin light brown irregular lines, reminding one of the surface-marking of the pupa of *Melanargia syllius*, but, in this case, the markings are not so pronounced. The first free abdominal segment has a wrinkled brown patch on each side extending as far as the spiracle and partly covered by the previous segment. Spiracles of medium size, oval and brown. Cremastral spike dark brown, straight and pointed. [The pupa described entered this stage at the end of June, 1902, the larva having been found on June 14th at Hyères.] (Powell).

[Page 158.] Habits of imago.—Occurs regularly twice a year at Hyères, in April and May and again in July and August. The May examples are not uncommon and are to be seen frequently flying round the flowers of red valerian, on which it loves to feed, and may sometimes be seen in considerable numbers, *e.g.*, in a gorge above La Farlède on May 1st, 1902, but they are very active and difficult to capture. They appear to feed quite as readily in full sunlight as at dusk, in the spring, yet I have no notes nor recollection of having seen summer specimens in the daytime, although they occur frequently at honeysuckle and other flowers in the evening, and I have known the species to come to the electric light (Powell).

Catalogue of the Palæarctic Sphingides.

Sphingides.
Eumorphidæ.
Hemarinæ.
Hemaridi.
Cochrania, Tutt
croatica, Esp.
Hemaris, Dalm.
ducalis, Staud.
dentata, Staud.
rubra, Hmpsn.†
saundersi, Walker †
staudingeri, Leech
var. ottonis, Roths. and Jord.
beresowskii, Alph.
affinis, Brem.
var. ganssuensis, Gr.-Grsch.
var. confinis, Staud.
var. alternata, Btl.
fuciformis, Linn.
ab. heynei, Bart.
ab. milesiformis, Tr.
var. robusta, Staud.
var. simillima, Moore
radians, Walk.
var. mandarina, Butl.
tityus, Linn.
var. alaiana, Roths. and Jord.
Cephonodidi.
Cephonodes, Hb.
hylas, Linn.
Sesiinæ.
Sphecodinidi.
Sphecodina, Blanch.
caudata, Brem. and Grey †
Sesiidi.
Sesia, Fab.
stellatarum, Linn.
bombylans, Walk.
passalus, Drury
Rhopalopsyche, Butl.
nycteris, Koll. †
Proserpininæ.
Proserpinidi.
Sphingonæpeopsis, Wallgrn.
gorgon, Esp.
kuldjaensis, Graes.
Proserpinus, Hb.
proserpina, Pallas
var. japetus, Grum-Grsch.
Darapsinæ.
Clarinidi.
Gurelca, Kirby
masuriensis, Butl.
var. sangaica, Butl.
Clarina, Tutt (Berutana, Roths. and Jord.)
kotschyi, Koll.
var. mardina, Staud.
syriaca, Led.
Acosmerygidi.
Ampelophaga, Brem. and Grey
rubiginosa, Brem. and Grey
var. fasciosa, Moore †
var. ienobu, Holld.
Acosmeryx, Bdv.
castanea, Roths. and Jord.
naga, Moore
Rethera, Roths. and Jord.
komarovi, Christ.
Daphnidinæ.
Daphnididi.
Daphnis, Hb.
nerii, Linn.
var. infernelutea, Saalm.
Eumorphinæ.
Eumorphidi.
Eumorpha, Hb.
elpenor, Linn.
ab. pallida, Tutt
ab. virgata, Tutt
ab. unicolor, Tutt
ab. clara, Tutt
ab. obsoleta, Tutt
var. lewisii, Butl.
var. macromera, Butl.†
rivularis, Bdv. (an *var.*) †
Theretra, Hb.
standfussi *hybr.*, Bartel
porcellus, Linn.
ab. clara, Tutt
ab. (et *var.*) scotica, Tutt
ab. indistincta, Tutt
ab. hibernica, Tutt
ab. suffusa, Tutt
ab. lutescens, Ckll.
suellus, Staud. (an *var.*)
Cinogon, Butl.
askoldensis, Obth.
Hippotionidi.
Cechenena, Roths. and Jord.
minor, Butl.
Rhagastis, Roths. and Jord.
confusa, Roths. and Jord. †
jordani, Obth. †
mongoliana, Butl.
Isoples, Hb.
nessus, Drury
var. rubicundus, Schaur.
boisduvali, Bugn.
alecto, Linn.
var. cretica, Bdv.
Xylophanes, Hb.
oldenlandiæ, Fab. †
Florina, Tutt
japonica, Orza

† On borders of Palæarctic region, doubtfully within.

var. suifuna, Staud.
Hippotion, Hb.
osiris, Dalm.
celerio, Linn.
PHRYXIDI.
Phryxus, Hb.
livornica, Esp.
Weismanuia, Tutt
zygophylli, Ochs.
Celerio, Oken
gallii, Rott.
ab. grisea, Tutt
ab. pallida, Tutt
ab. incompleta, Tutt
ab. stricta, Tutt
ab. lata, Tutt
phileuphorbia? *hybr.*, Mütz.
Hyles, Hb.
tithymali, Bdv.
mauretanica, Staud.
var. deserticola, Bart.
ab. flaveola, Obth.*
dahlii, Hb.-Gey.
ab. lutescens, Obth.*
euphorbiæ, Linn.
ab. suffusa, Tutt
ab. rubescens, Garb.
ab. rufomelana, Tutt
ab. helioscopiæ, Selys-Longch.
ab. lafitolii, Thierry-Mieg
ab. esulæ, Bdv.(nigrescens, Roths. and Jord.)
ab. restricta, Roths. and Jord.
var. (et *ab.*) grentzenbergi, Staud.
var. paralias, Nick.
var. peplidis, Christ. (?=robertsi, Butl.)
conspicua, Roths. and Jord. (an *var.*)
siehei, Püngeler (an *var.*)
centralasiæ, Staud. (an *var.*)
robertsi, Butl. (an *var.*)
nervosa, Roths. and Jord.† (an *var.*)
costata, Nordm. (an *var.*)
nicæa, Prun.
var. lathyrus, Walk.
var. castissima, Aust.
ab. carnea, Aust.
epilobii *hybr.*, Bdv. (an *ab.*)
eugeni *hybr.*, Mory (an *ab.*)
lippei *hybr.*, Mory (an *ab.*)
pauli *hybr.*, Mory (an *ab.*)
Thaumas, Hb.
vespertilio, Esp.
ab. salmonea, Obth.*
ab. burckhardti, Mory
Turneria, Tutt
vespertilioides *hybr.*, Bdv.
hippophaes, Esp.
bienerti, Staud.
SPHINGIDÆ.
SPHINGINÆ.
HYLOICIDI.
Hyloicus, Hb.
crassistriga, Roths. & Jord.
pinastri, Linn.
ab. typica-virgata, Tutt
ab. fasciata, Lampa
ab. asiaticus, Btl.
ab. grisea, Tutt
ab. grisea - transversa, Tutt
ab. grisea - mediopuncta, Tutt
ab. grisea-distincta, Tutt
ab. virgata, Tutt
ab. unicolor, Tutt
var. morio, Roths. & Jord.
caligineus, Butl. (an *var.*)
var. sinicus, Roths. & Jord.
oberthueri, Roths. & Jord.
SPHINGIDI.
Sphinx, Linn.
ligustri, Linn.
ab. albescens, Tutt
ab. pallida, Tutt
ab. subpallida, Tutt
ab. lutescens, Tutt
ab. incerta, Tutt
ab. intermedia, Tutt
ab. obscura, Tutt
ab. brunnea, Tutt
ab. spiraeae, Esp.
var. amurensis, Obth.
var. constricta, Butl.
COCYTIIDI.
Psilogramma, Roths. & Jord.
menephrou, Cram. †
var. increta, Walk.
Meganoton, Bdv.
aualis, Feld. †
AGRIIDI.
Agrius, Hb.
convolvuli, Linn.
ab. grisea, Tutt
ab. intermedia, Tutt
ab. fuscosignata, Tutt
ab. virgata, Tutt
ab. variegata, Tutt
ab. suffusa, Tutt
ab. obscura, Tutt
ab. alicea, Neub.
ab. major, Tutt
ab. minor, Tutt
var. batatæ, Christ
var. orientalis, Tutt
MANDUCIDI.
Manduca, Hb.
atropos, Linn.
ab. suffusa, Tutt

* To be described in Oberthür's *Lépidopterologie comparée* now in press.
† On borders of Palæarctic region, doubtfully within.

ab. obsoleta, Tutt
ab. imperfecta, Tutt
ab. conjuncta, Tutt
ab. extensa, Tutt
ab. intermedia, Tutt
ab. virgata, Tutt
ab. variegata, Tutt
ab. flavescens, Tutt
ab. sculda, Kirby
styx, Westd.
var. medusa, Moore (crathis, Roths. & Jord.)

AMORPHIDÆ.
SPHINGULINÆ.
SPHINGULIDI (KENTROCHRYSALIDI).
Sphingulus, Staud.
mus, Staud.
Kentrochrysalis, Staud.
sieversi, Alph.
davidis, Butl. (consimilis, Roths & Jord.)
streckeri, Staud.
var. davidis, Obth.
Dolbina, Staud.
tancrei, Staud.
exacta, Staud.
AMBULICINÆ.
AMBULICIDI.
Akbesia, Roths. and Jord.
davidi, Obth.
Oxyambulyx, Roths. and Jord.
schauffelbergeri, Brem. and Grey
ochracea, Butl.
AMORPHINÆ.
CLANIDI.
Clanis, Hb.
bilineata, Walk.
undulosa, Moore †
LEUCOPHLEBIIDI.
Leucophlebia, Westd.
lineata, Westd.
MIMANTIDI.
Parum, Roths. and Jord.
colligata, Walk. (bieti, Obth.)
Mimas, Hb.
tiliae, Linn.
ab. pallida - transversa, Tutt
ab. bipunctata, Clark
ab. pallida - costipuncta, Tutt
ab. pallida-marginepuncta, Tutt
ab. pallida - centripuncta, Tutt
ab. pallida-obsoleta, Tutt
ab. maculata, Wallgrn.
ab. costipuncta, Clark
ab. marginepuncta, Tutt
ab. centripuncta, Clark
ab. obsoleta, Clark
ab. brunnea - transversa, Tutt
ab. brunnea, Bart.
ab. brunnea - costipuncta, Tutt
ab. brunnea - marginepuncta, Tutt
ab. brunnea-centripuncta, Tutt
ab. brunnea-obsoleta, Tutt
ab. virescens - transversa, Tutt
ab. virescens - maculata, Tutt
ab. virescens-costipuncta, Tutt
ab. virescens - marginepuncta, Tutt
ab. virescens-centripuncta, Tutt
ab. virescens - obsoleta, Tutt
ab. lutescens, Tutt
ab. suffusa, Clark
ab. ulmi, Bdv.
ab. pechmanni, Hartmn.
christophi, Staud.
ab. alni, Bart.
leoniæ *hybr.*, Stdfss.
SICHIIDI.
Burrowsia, Tutt
gaschkewitschi, Brem. & Grey
var. carstanjeni, Staud.
var. complacens, Walk.
var. echephron, Bdv. (roseipennis, Butl.)
Marumba, Moore
dyras, Walk.†
Kayeia, Tutt
maacki, Brem.
jankowskii, Obth.
sperchius, Mén.
Sichia, Tutt
quercûs, Den. & Schiff.
LANGIIDI.
Langia, Moore
zenzeroides, Moore
var. nawai, Roths. & Jord.
SMERINTHIDI.
Callambulyx, Roths. & Jord.
tatarinovi, Brem. & Grey
var. eversmanni, Evers.
Daddia, Tutt
kindermanni, Led.
var. orbata, Grum-Grsch.
var. obsoleta, Staud.
Bellia, Tutt
cæcus, Mén.
Smerinthus, Latr.
ocellata, Linn.

† On borders of Palæarctic region, doubtfully within.

ab. albescens, Tutt
ab. pallida, Tutt
ab. rosea, Bart.
var. cinerascens, Staud.
var. atlanticus, Aust.
var. atlanticus-æstivalis, Aust.
hybridus *hybr.*, Stphs.
fringsi *hybr.*, Stdfss.
oberthueri *hybr.*, Tutt
planus, Walk. (an *var.*)
AMORPHIDI.
Amorpha, Hb.
populi, Linn.
ab. roseotincta, Reuter
ab. suffusa, Tutt
ab. rufescens, Selys
ab. fuchsi, Bart.
ab. pallida, Tutt
ab. tremulæ, Bkh.
var. austauti, Staud.
ab. austauti-incarnata, Aust.
ab. austauti-mirabilis, Aust.
ab. austauti-staudingeri, Aust.
ab. austauti-flava, Bartel
var. populeti, Bienert
var. populetorum, Staud.
amurensis, Staud.
ab. rosacea, Staud.
var. sinica, Roths. & Jord. †
metis *hybr.*, Aust.
inversa *hybr.*, Tutt
PHYLLOSPHINGIIDI (CLARKIIDI).
Phyllosphingia, Swinh.
dissimilis, Brem.

ILLUSTRATIONS.

EXPLANATION OF PLATE I.

Larva of *Daphnis nerii* (described pp. 489 *et. seq.*).
Pupa of *Daphnis nerii*, dorsal, lateral, and ventral views (described pp. 492 *et. seq.*).
(Figures from drawings made by Mr. J. C. Dollman.)

EXPLANATION OF PLATE II.

Aberrations of *Manduca atropos*.
Manduca atropos ab. *virgata*, Tutt (top figure).
Manduca atropos ab. *variegata*, Tutt (middle figure).
Manduca atropos ab. *extensa*, Tutt (bottom figure).
(From specimens in the Brooks' collection.)

† On borders of Palæarctic region, doubtfully within.

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VOL. I.

* Note. Non-British forms are given in parentheses.

* Note. Non-British forms are given in parentheses.

VOL. III.

VOL. IV.

GENERAL INDEX—VOLS. I TO IV.

* For the arrangement of the hairs, tubercles, &c., &c., in the different species, see paragraph LARVA in the account of each separate species.

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